THE INSTITUTION OF PRODUCTION ENGINEERS JOURNAL

R V.32 1953

THE INSTITUTION OF
PRODUCTION ENGINEERS JOURNAL

36 PORTMAN SQUARE . LONDON . W1 Telephone: WELbeck 6813/7

Vol. 32, No. 1 *Price 10/-* *January 1953*

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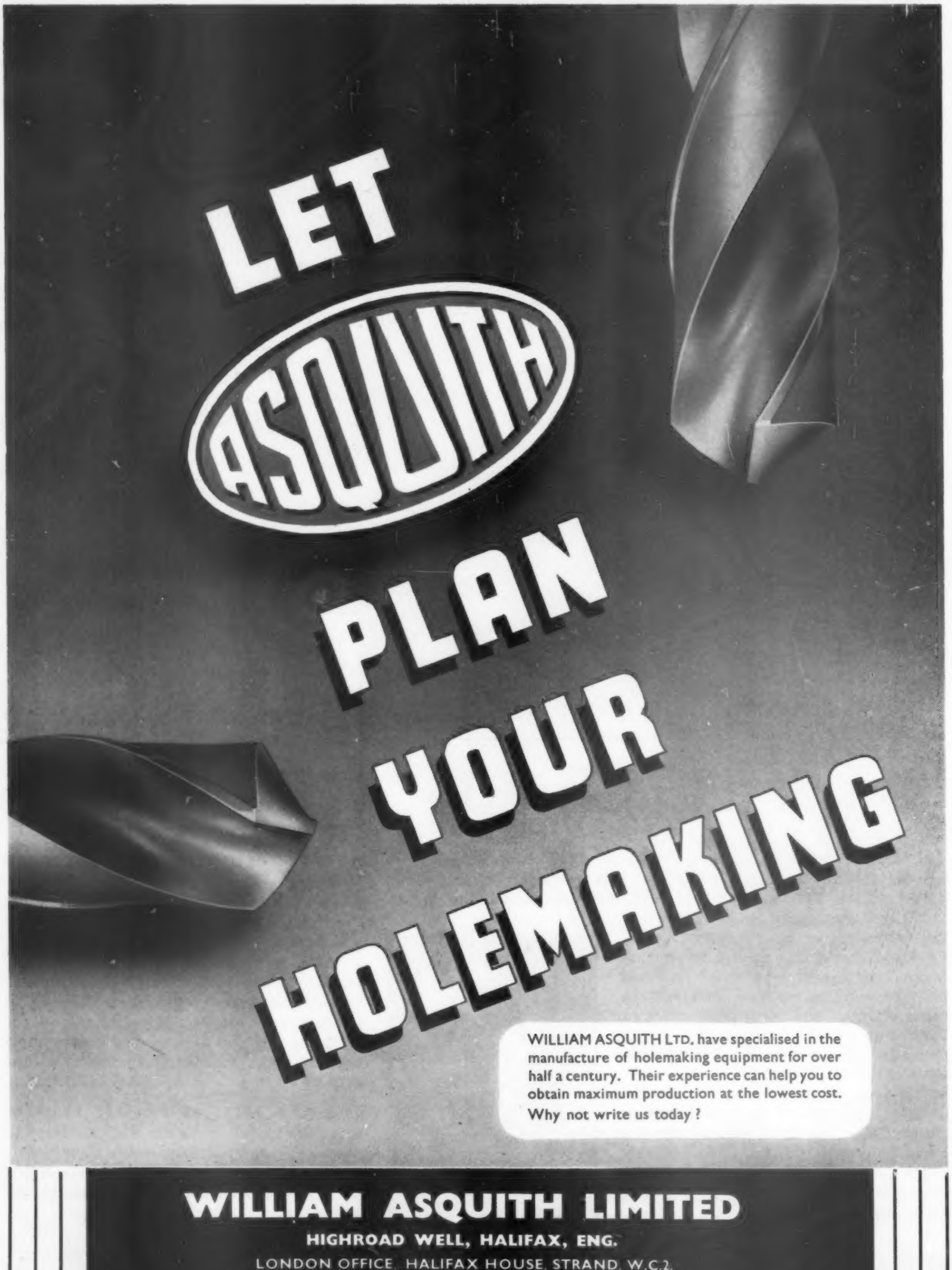
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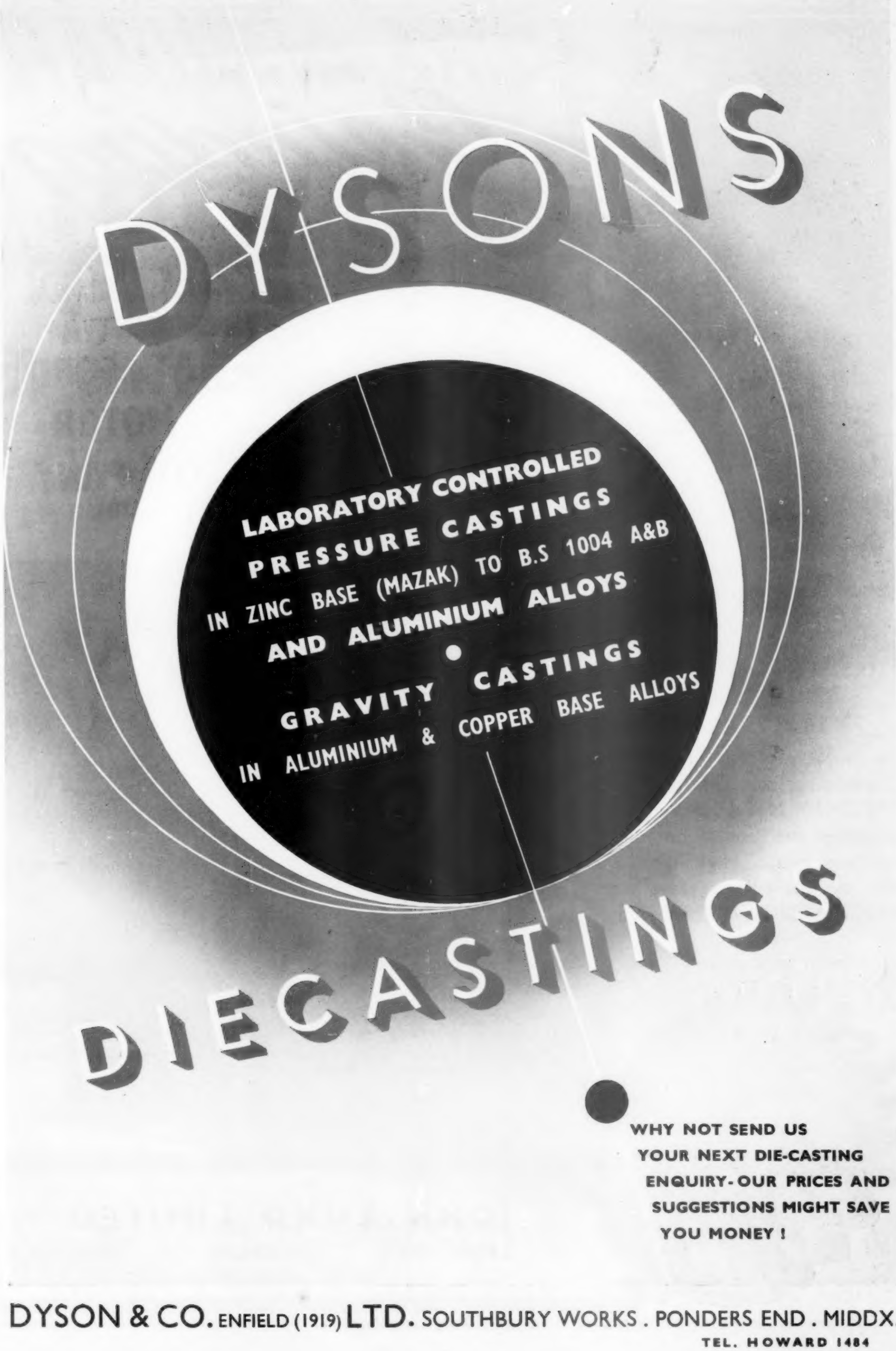
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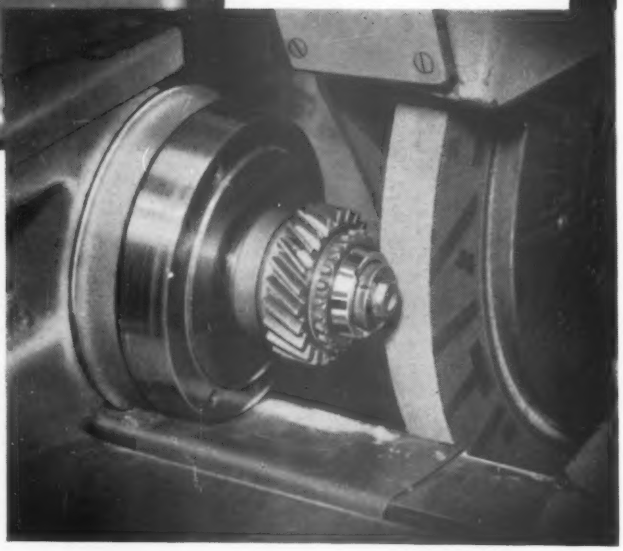

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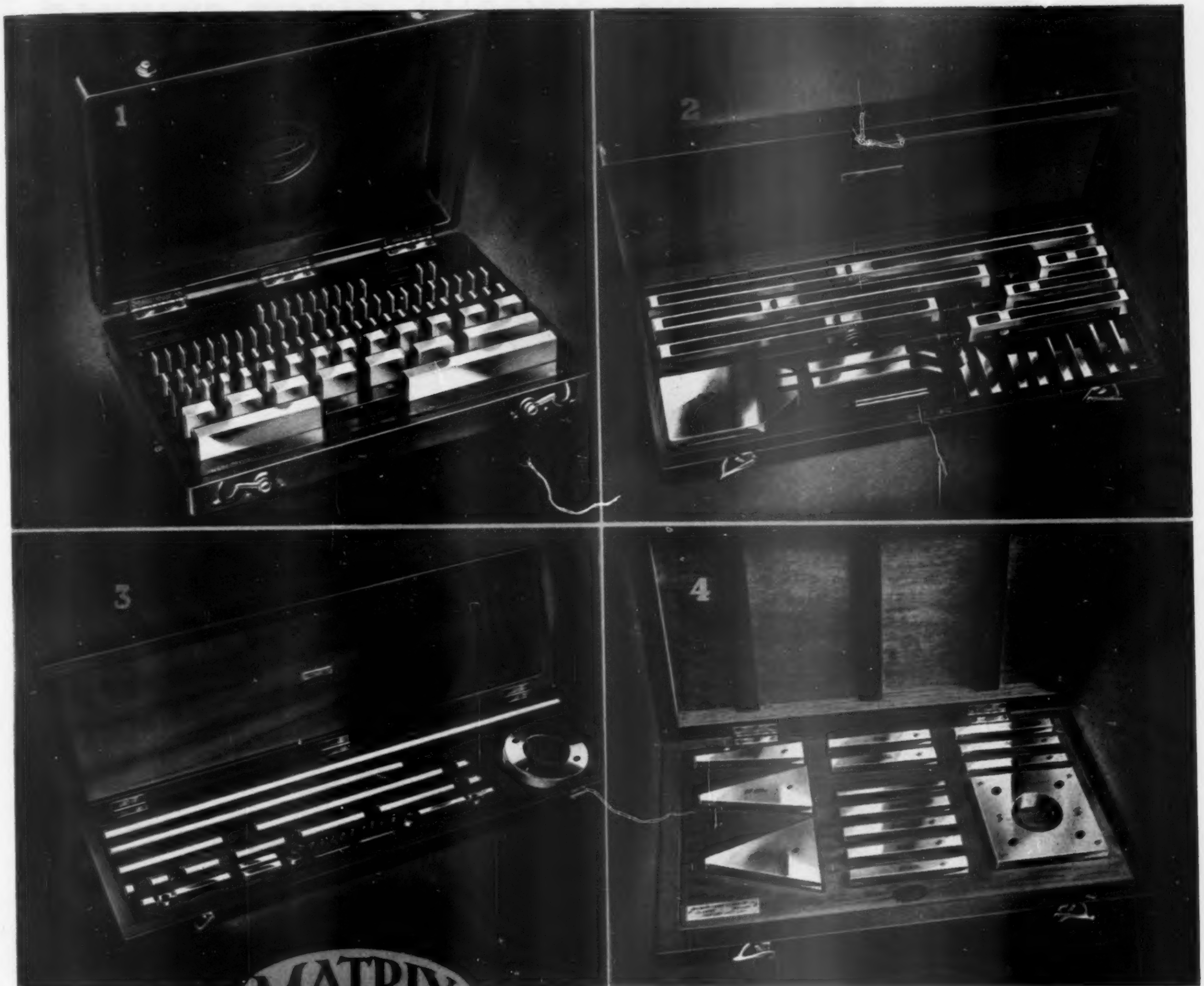
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Our Duty to The Nation

by the President of the Institution,
SIR CECIL WEIR, K.C.M.G., K.B.E., M.C., D.L.

I AM writing this article in Luxembourg, where I am spending much of my time nowadays as Head of the United Kingdom Delegation to the European Coal and Steel Community, in order that it may appear in the first issue of our Journal in its new form. What is going on in Luxembourg should be studied by our members. It is the biggest ever exercise in the wider fields of politico-economic production engineering that has so far been attempted in the history of man. The result of this supranational experiment, in the sphere of the basic industrial products of coal and steel of six nations containing a population not far short of one hundred and sixty millions, will be significant for the peaceful co-operation and association of the free peoples of Europe and indeed of the world. It may usher in a new form of partnership and collaboration, even of integration, in vital areas of human interest and endeavour and eliminate causes of conflict which in the past have plagued and tortured mankind. It is a privilege and an intensely interesting experience to be associated in the way that the United Kingdom is with this brave and venturesome enterprise.

I am very glad that in my year of office as President of the Institution the Journal, which is such a valuable and essential instrument of our organisation, should be assuming a shape and appearance appropriate to the progress that has been made in the development of our work and of our influence in recent years. Good craftsmen are all the better for having good tools and, consequently, the Institution requires the best possible medium for the dissemination of professional knowledge, for making known the ideas of its members and publishing the views of authorities on various aspects of production engineering. I feel that the Editorial Committee has done a good job in devising such an excellent form of Journal, and I wish the publication every success in the days to come.

The progress of the Institution of Production Engineers, now recognised everywhere as a most valuable professional body, has marched in step with a growing realisation in British industry of the importance of production engineering. The membership has risen from 3,069 ten years ago to 9,369 today. We can confidently expect this progress to continue without interruption in the United Kingdom and in the Commonwealth countries. Already we have established branches in various parts of the Commonwealth and in their interest and ours, it is important that we should press on with the expansion of Sections of the Institution in areas overseas in which we are developing more and more mutual trade and which are part of the British family of nations.

The Institution is not a competitor of other professional organisations which are performing vital tasks in special fields. It can, indeed, be said to be the partner and servant of them all since its operations concern almost every aspect of efficiency in manufacturing processes and bring together in the service of productivity and cost economies, the best and most effective of all the individual techniques.

There is no industry in which there is not a place for the Production Engineer. There is, indeed, no type of production which does not require at some of its stages the trained engineer. The Institution must therefore extend its services and its training throughout the whole field of British and Commonwealth industry, and invite manufacturers and their forward-looking employees to take advantage of the facilities which the Institution can offer.

In the relatively short period of my association with the Institution I have been particularly impressed by the activity, energy and enthusiasm of the numerous Sections spread over the United Kingdom. Already I have had the pleasure of visiting a number of Sections and of taking part in the inauguration of new ones. It seems to me that the keenness of the Sections in centres of industrial production and the opportunity thus afforded to

younger people in industry to participate in studies and activities carried out in their own localities, is one of the particular advantages of this Institution; more especially when the Sections are served, as I have seen to be the case, by an energetic and well informed headquarters. A form of devolution has been developed which combines the benefits of central aid and direction with a large measure of local autonomy and operation.

My experience in attending the Summer School last August at Ashorne Hill strengthened my conviction of the desirability of organising meetings of members to be held in different parts of the country, for exchanges of knowledge, of information and of views. I believe that the practical possibilities of enlarging such opportunities for mutual instruction could profitably be examined.

The days of the seller's market are passing away. In some industries competition in the domestic market, and with the industries of other countries in their markets, is already fierce in quite a number of products and it will become increasingly evident in industry generally.

We in Great Britain depend more than any other country on the maintenance and expansion of our export trade, and we must provide our manufacturing industry with the most efficient instruments, human and mechanical, that training and ingenuity and invention can contrive. In order that we should succeed in our efforts and take our proper and traditional place in a free world economy, we must be able to accept and to meet competition from wherever it may come. This means maximum productivity, high standards of quality, low costs of production, high standards of living, good conditions of work, attractiveness of products, eager and enterprising salesmanship. This may sound quite a large and difficult object to achieve, but it must be done if we are to go ahead and it is, in large degree, a job for the Production Engineer.

The Task of The British Productivity Council

by S. P. CHAMBERS, C.B., C.I.E.,
Deputy Chairman, I.C.I., LTD.

THE British Productivity Council was set up in November, 1952, as a successor to the U.K. Section of the Anglo-American Council on Productivity, and many people may be wondering whether the decision to set up yet another public body is right and whether this new body could make any contribution either to British industry or to the British economy as a whole.

The Anglo-American Council on Productivity performed an outstanding service in sending Teams from Britain to the United States to examine the differences between the organisation and methods employed in the industries of the two countries. The Reports of those Teams, whose members were drawn from various ranks of management and workers, have undoubtedly led, and are still leading, to improvements in organisation methods and the attitude to work in this country. What is there left for the newly-formed British Council of Productivity to do ? Is it not better to let individual businesses apply in their own way the lessons which have been learned as a result of the visits to America ; are we likely to get improvements introduced and productivity raised in any other way ?

The answer is that, although productivity depends ultimately upon the individual initiative and drive of management, the capital at its disposal, and the skill and energy of employees of all ranks, the results achieved so far are not good enough, and there is still an *important* public duty to be done by a representative body such as the British Productivity Council.

It is no exaggeration to say that a substantial, but not impossible, increase in productivity would enable us not merely to meet our rearmament obligations while maintaining our standards of living, but in time, to go further and to raise the standards of living and solve our balance of payments problems.

The task of the British Productivity Council is to examine carefully all the obstacles which stand in the way of a steady and substantial advance in productivity and then to consider what action should be taken to remove these obstacles.

The greatest enemy of productivity is ignorance. Ignorance of better methods of work, or of organisation, or of rewarding work, means that the use of existing equipment is less efficient than it need be. Ignorance of the elementary fact that more capital per worker means higher productivity leads to misguided attacks upon the rewards paid to those who supply industry with capital out of their savings.

How many workers in this country know that capital—real capital—is essential for all industries whether owned by private individuals, by small or large industrial companies, or by the Government ? How many realise that in the United States there is about two and a half times as much capital per worker as there is in this country and that this is the major reason for the greater productivity per head in that country ? How many know that capital can come only from current savings, whether by individuals or by companies ; or that, in 1951, savings put into industrial equipment in the United States was over thirty times what it was in this country, which is more than ten times as much per head ? How many people in industry, whether they are classified as salaried staff or as on the payroll, understand the problems of management in trying to get their production costs down and their prices competitive while paying fair wages for honest work and fair rewards in the shape of dividends to those who put their savings into the business ? How many politicians, on the other hand, are prepared to pay lip service to the virtues of mechanisation and modernisation but are silent when they are told by irritated industrialists that these things cannot be done by waving a wand or by making impressive speeches, but need capital which they cannot get because there are no savings ?

Because ignorance is the greatest enemy of productivity the main task of the British Productivity Council is to find ways and means of teaching not only management and payroll workers, but those who represent us in Parliament as well, some elementary lessons based upon the fundamental truth that our standards of living depend upon our productivity. Our productivity is not likely to rise adequately unless there is a much better understanding of the causes of low productivity and concerted attacks are made upon these causes from all sides. This means that much more attention must be paid to such matters as work and method study, adequate rewards for work and savings, the provision of more capital, and the improvement of marketing, particularly overseas. It is significant that no less than forty out of the fifty-two Reports issued by the Productivity Teams which visited the United States, put specifically on record their conviction that an important factor in the higher productivity in that country was the greater appreciation there of the need for higher productivity.

A modest increase in productivity in this country is not enough if it does not match the increasing productivity in other countries whose products compete with ours. Competition from such countries as Germany and Japan, as well as from the United States, is growing. There is no doubt that in Britain we have some special advantages which could lead to much higher productivity and therefore to higher standards of living. But if we fail to make use of our opportunities through ignorance, indifference or obsession with less important and less relevant matters, we can fall behind our competitors and our standards of living can go down instead of going up. They can go down a long way and that means unemployment and misery. Once our standards have fallen it will be most difficult to get them to rise again because with a low standard of living the problem of capital shortage, which is now acute, will become chronic, as it is in certain Asiatic countries.

The membership of the British Productivity Council is very wisely drawn from a wide circle and includes not only representatives of management in private industry and commerce, but representatives of Trades Unions and the nationalised industries. There is a difficult and important job to be done and it is good to know that a very strong team has been chosen. They need and deserve our goodwill and co-operation, whether we are executives, works managers, payroll workers, trade union officials, or politicians.

MEASUREMENT OF PRODUCTIVITY

by B. H. DYSON, M.I.Prod.E., F.I.I.A.

(Presented to the Manchester Section of the Institution on 22nd September, 1952)

Mr. Dyson, who is General Works Manager responsible for all Hoover factories, and a Director of Hoover (Washing Machines) Ltd., is a Member of Council of the Institution of Production Engineers and has taken a leading part in the development and progress of the Institution. He is Vice-Chairman of the Research Committee, Joint Chairman of the Joint Committee on the Measurement of Productivity, and a member of the Awards Sub-Committee. He has also served on the Education Committee.

Apprenticed with Heatley-Gresham Ltd., Letchworth, Mr. Dyson subsequently spent five years in America, where he gained considerable engineering and production experience. Upon his return he held positions in charge of production engineering departments in aircraft, scientific instrument and electrical concerns, joining Hoover Ltd., in 1937.

B. H. Dyson

IT is now generally accepted that increased industrial productivity at economic costs is Britain's fundamental need. On this depends the possibility of our products being competitive in overseas markets, on which our external balance of payments and our standard of living at home depend.

In the immediate post-war years the most urgent national problem was, " How much production ? " Today this has become " Production at how much? " There is, of course, a big difference between increased production and increased productivity. Present high costs of production are not only a threat to individual industries, but are detrimental to the general prosperity and living standards of the nation.

What is Productivity ?

Evidence that the need to improve productivity and reduce costs is now recognised is found in company chairmen's speeches, in technical journals, in Institution meetings and in the daily Press. Yet the principles of productivity are not new. In the Bible we read that " The labourer is worthy of his hire "; St. Paul wrote, " Masters give unto thy servants that which is just and equal "; and in the Gospel according to St. Matthew there is the parable of the talents. There is much in these quotations to cause us to reflect. We find these ideas expressed in Frederick Taylor's paper, " A Piece Rate System," presented in 1895, in which he attempted to detail his method of assessing a " fair day's work for a fair day's pay."

For those who like definitions, I think there is much to commend the simple one that productivity is " to make two ears of corn grow where only one grew before." The British Institute of Management defines productivity as " the volume of output which is achieved in a given period in relation to the sum of direct and indirect effort expended in its production." But I believe that the fundamental position was summed up by the Anglo-American Productivity Teams who said that " productivity is an attitude of mind " and " we are convinced that it is efficient management who set the pace of productivity in American industry."

Indeed, experience has shown that in the most successful British firms where productivity is equal or in advance of that in American or continental plants, it is invariably the result of the high standard of expectancy of their progressive managements. Possibly the most dangerous factor in Britain today is our acceptance of the lowering of our standard of expectancy. How can we expect a higher standard of living and give less effort for it ?

I think it reasonably safe to predict that over the next five years at least, no new far-reaching production technique, manufacturing process or machine tool at present unknown will be evolved to revolutionise productivity in British industry. The development by management and labour of the most efficient ways of performing the numerous day-to-day tasks will contribute more to our industrial well-being, than a few startling labour-saving inventions that displace large numbers of workpeople.

More detailed knowledge of the basis of industrial efficiency is available now than ever before and Production Engineers have a particular responsibility for exchanging this information, and making it available for the achievement of greater industrial efficiency at lower costs, while maintaining at the same time high levels of employment. Having spent many years in American industrial plants and being well acquainted through personal visits and contacts with many industrial centres in Europe, I am confident that British industry has every opportunity of equalling, and in most cases of surpassing, American achievements in efficiency.

The American Example

At this point I think it would be appropriate to indicate what might be some misconceptions about America's supposed advantages.

1. *The Large Home Market*

It all depends on what is meant by "a large home market." In the 48 States of the U.S.A., covering 3,750,000 square miles, there are 150,697,000 people. In the British Commonwealth, covering 14,435,000 square miles, there are 539,870,000 people. It is also worth remembering that in the U.S.S.R.'s 8,337,000 square miles, there are 194,390,000 people. Perhaps we must give much more attention to achieving a United States of British Commonwealth.

2. *Large Versus Small Industrial Concerns*

In the U.S.A. there are 99,400 firms employing less than 100 people, comprising in all 22 per cent. of the total number employed. In Great Britain there are 41,400 firms of 100 people, comprising 21 per cent. of the people employed. Firms with over 1,000 employees total 1,935 in the U.S.A. and account for 34 per cent. of all those employed. In Great Britain there are 943 firms employing over 1,000 and these account for 31 per cent. of the people employed. (Chart 1)

3. *Availability of Food and Consumable Goods*

The plentiful supply of consumer products is cited by some of the Anglo-American Productivity Teams as a reason for higher productivity in America. But on this basis one would expect from the evidence of the plentiful supplies of meat and other foods in, say, France or Holland, and the well-filled shops in Belgium or Switzerland, that productivity in these countries should at least equal that of America. This factor does not appear to provide the answer to the problem of increasing productivity. (Chart 2)

Perhaps the real answer is to be found in the experience of the American cotton textile industry. In 1885, the Americans were shocked to find that their cotton textile industry was badly lagging behind the highly mechanised Lancashire mills. Their investigation of this low productivity showed that although there was a desperate shortage of labour, far too much manpower was being used in the old-fashioned American mills ; moreover, as a result of the acute labour shortage, labour costs were very high. It was imperative, therefore, for them to obtain the highest productivity. Could it be that in Britain today our fundamental problem is that we have too much manpower or too little industrial activity ?

In 1890, in an effort to remedy the low output in the textile and other industries in the U.S.A., productivity research was undertaken. These early investigations took the form of detailed factory studies and an exhaustive analysis was made, on a departmental basis, of the relationship between output and man hours expended. The major emphasis in these studies was on the mechanical replacement of hand work; in fact, the reports were entitled " Productivity of Hand and Machine Labour."

Last year, the U.S. Department of Labour made 5,000 visits to manufacturing plants to further the annual programme for reporting and evaluating the conditions affecting factory production efficiency. Over 2,600 companies in the twenty industries already covered in the programme are exchanging information on their methods of setting targets and measuring productivity.

Wages and Productivity

In Britain, one of our most pressing problems at the moment is the claims for salary and wage increases out of the profits of industry to offset the cost of living. The linking of salaries and wages to changes in the level of prices, without consideration of the volume of production, can lead to an attempt to share out what has not in fact been produced. On the other hand, at a time of rising productivity at

COMPARISON OF THE SPREAD OF MANUFACTURING INDUSTRY AND POPULATION

	GREAT BRITAIN			U.S.A.		
Size	No. of Establishments	Number Employed	per cent. Number Employed	No. of Establishments	Number Employed	per cent. Number Employed
Employing up to 49 ...	31,285	787,000	11 per cent.	80,662	1,806,000	13.1 per cent.
50—99 ...	10,138	710,000	10 per cent.	18,672	1,300,000	9.0 per cent.
100—499 ...	11,324	2,368,000	34 per cent.	19,878	4,161,000	30.2 per cent.
500—999 ...	1,439	984,000	14 per cent.	2,729	1,883,000	13.7 per cent.
over 1,000 ...	943	2,099,000	31 per cent.	1,935	4,671,000	34.0 per cent.
TOTAL ...	55,129	6,948,000	100 per cent.	240,881	13,821,000	100.0 per cent.

COMPARISONS OF POPULATION AND AREA

	Area (sq. miles)	Population
BRITISH POSSESSIONS	14,435,000	539,870,000
U.S.A.	3,750,000	150,697,000
U.S.S.R.	8,337,000	194,387,000

Chart 1

COST OF LIVING COMPARISONS

	ENGLAND		FRANCE		HOLLAND		GERMANY		NORWAY		SWITZERLAND	
	£ s. d.	Per Hr.	Frs.	Frs. Per Hr.	H. fl.	H. fl. Per Hr.	DM	DM Per Hr.	Kr.	Kr Per Hr.	S. Fr.	S. Fr. Per Hr.
Gross Wages per month for skilled production turner (one who can set own machine and work on quantities of 5 to 500)	40 12 0	4/6d.	33000	165	249·60	1·25	400	2·0	800	4	600	3
Hours worked per month	180		200		200		200		200		200	
Nett Wages per month after direct taxation (Married, 2 children)	39 7 8	4/4½d.	31120	155·6	236·90	1·18	350	1·75	665	3·3	520	2·6
		*Std. Hrs.**		*Std. Hrs.**		*Std. Hrs.**		*Std. Hrs.**		*Std. Hrs.**		*Std. Hrs.**
Rent and Rates per month	6 0 0	27·5	3850	24·7	35·0	29·6	35	20·0	110	32·5	100	38·5
COMMODITIES												
1 kg. Meat	6 2	1·41	760	4·8	4·50	3·81	4·50	2·57	9	2·73	6·20	2·4
1 kg. Bread	10	·19	80	·52	0·57	·483	0·70	0·40	0·75	0·23	0·59	0·23
1 Pair of Boots ..	2 2 6	9·72	3750	24·1	25·0	21·2	30	17·2	65	19·7	40	15·4
1 Suit (Men's) ..	8 15 0	40·0	19000	122·2	150·0	127·0	130	74·3	250	76	180	69
1 Cycle	16 16 0	76·7	18000	116·0	175·0	148·0	150	85·7	320	97	350	135
1 Radio	21 0 0	96·0	18000	116·0	150·0	127·0	250	143·0	400	121	400	154
1 Refrigerator	58 0 0	265·0	75000	482·0	400·0	339·0	600	343·0	900	273	650	271
1 Vacuum Cleaner ..	21 0 0	94·0	20000	128·5	165·0	140·0	180	102·8	375	114	120	46
1 Motor Car	490 0 0	2240·0	420000	2700·0	5225·0	4430·0	600	2630·0	12000	3650	5930	2280
1 Kilowatt of Electricity	5	0·1	16	0·07	0·25	0·16	0·17	0·1	0·04	0·012	0·12	0·046
1 Cubic Metre of Gas	2½	0·05	31	0·13	0·15	0·1	0·23	0·13	—	—	0·25	0·096

* Calculated at nett earnings.

Chart 2

constant costs, application of the cost of living principle could deprive salary and wage earners of the benefits of the increase in productivity. (Chart 3)

In this connection I would like to quote from a recent report from the American Department of Labour :—

"It is largely the constant improvement in productive efficiency, as measured by an increasing quantity of goods produced per total man employed, that now makes possible both cost reduction and high wages and has thereby accounted for the raising of the American standard of living to its current high level. If we are to maintain this standard of living for an increasing population, we must continue to improve the average productivity of our industries. If we do not, our experience will parallel that of our European neighbours, who have suffered losses in their standard of living as their industrial productivity failed to increase during the past decade."

In Britain today we often hear it said : "If we could only get people to work as they did during the war—like the pilots in the Battle of Britain, like the men at Alamein and Arnhem, like they did after Dunkirk—things would be different." Well, why were these high levels of effectiveness achieved ? Simply because the environment and the level of expectancy aroused great physical, mental, and spiritual effort.

I want to emphasise the importance of environment because most of us are affected by our surroundings and we react to what our colleagues or workmates expect. The prevailing tempo in a department or company largely conditions the working pace, and conscious recognition of being part of a well-organised team operating at high efficiency will have a positive influence on productivity.

Why Measure Productivity ?

The importance of measuring productivity is now fairly clear. In Britain we accept the need to increase productivity, but high productivity will not be achieved unless the targets of expectancy are realistic. For productivity, it must be remembered, does not mean only the effectiveness of direct labour. It includes also the effectiveness of such things as indirect labour, machine utilisation, handling and transport of materials, administration and management.

For a number of years many industrial firms have used financial records like standard costs, budgetary control, monthly, quarterly, and annual accounts, to record the effectiveness of operating conditions. Statistics have been compiled and used by economists to assess relative efficiencies in industry, to forecast trends, and to indicate national annual targets. Valuable as such records may be, there is needed also a way of measuring the effectiveness of each industrial function. It is particularly important that the method used is such that both the targets set and the measurement achieved are understandable by factory managers, foremen, shop stewards, craftsmen, and operators.

Clearly, with no goal posts there can be no goals.

REVIEW OF WAGE PAYMENT METHODS

Monthly or Weekly Payment is the only Method that can give any feeling of a sense of security.

	METHOD OF PAYMENT	CONDITIONS OF PAYMENT	
Time Base	**Monthly** **Weekly** **Hourly**	**Without carefully set task** **With carefully set task**	**Without individual performance reports** **With individual performance reports** **With or without measured job and man evaluation**
Production Base	**Contract** **Piece Work** **Bonus or Premiums**	**Sub-contract allotments set task** **Individual work gang set task** **Individual group or team**	**Without day guarantee** **Straight price guarantee** **Straight piece price** **With or without time wage guarantee** **With time wage guarantee** **With set time and quantity** **Rowan system** **Halsey system** **Haynes " Manit "** **Bedeaux " Point "** **Evaluation** **With or without Time Study base**
Service Base	**Merit Rating—Assessment of ability qualities** **Job Rating—Assessment of job evaluation** **Personal Rating**	**Length of service** **Attendance records** **Punctuality records** **Suggestion participation**	
Profit Sharing	**By Investment** **By Contract** **Independent of wages**	**Set profit target** **Job profit** **Factory efficiency** **Company profit**	

FAIR DAY'S WORK FOR A FAIR DAY'S PAY

Labour like capital tends to get what it produces. Wages are paid out of profits from production and merchandising, and cannot permanently remain above the point where profit ceases.

Chart 3

with no winning post and time recording device there can be no measurement of the race. Although nationally stated targets may make pretty publicity posters and a target for an industry may be good for the managers, for the purpose of daily achievement the more positive individual mine or factory target is needed.

Yet I wonder what answers we would get if we went to the gates of half-a-dozen factories and asked some of the employees the following questions :—

(1) What is your company's target for production this week ?

(2) What is your department's or your own individual target for achievement this week ?

(3) What are the achievements today against those targets ?

And if we think that the workpeople or office staff in our own factories would be unable to answer these questions, how can we expect high productivity from them ?

To desire the mental satisfaction of knowing how one is progressing is, after all, only human, and so is the satisfaction of knowing that the Supervisor or Boss is aware of one's achievements. This is as true of supervisory staff as it is of people employed in the office or on the factory floor, and the use of targets is a practical recognition of these desires. By setting individual, team, and departmental targets and displaying both the daily requirements and achievements, the total results in one particular factory reached 99.6 per cent. of the production schedule over the year of 1951.

Some Applications of Productivity Measurement

In London, in November, 1948, as a result of a one-day Conference held to consider what contribution the Production Engineer and the Cost Accountant could make to meet the need for greater productivity, a Joint Committee of the Institution of Production Engineers and the Institute of Cost and Works Accountants was formed. The objects of this Joint Committee were :—

(a) to devise the best means of measuring comparative productivity, and

(b) to devise ways of applying these methods for the purpose of increasing productivity.

One of the Committee's principal tasks has been to illustrate by example the advantages of a standard of measurement that could be used to compare productivity within given industries, between factories, offices and departments. From management's point of view such a standard of measurement had to be comprehensible to departmental supervisors and applicable in the office and on the factory floor.

Many manufacturing companies have their own standards and measure their effectiveness against previous manufacturing costs, factory costs, or a standard cost, but these standards often refer to a finished product and cannot readily be used for comparing the efficiency of different departments, nor can they be used for inter-firm or inter-industry comparison. Any two companies may be manufacturing to meet entirely different markets, while their ratio of manufactured or bought-out parts will vary.

Process Assessment

But although comparative assessment of productivity on the basis of a product is often impossible, it is possible to compare productivity on the basis of processes. For instance, the process of automatic machine turning is comparable in many organisations; the processes of diecasting and plastic moulding can also be compared where applicable. Internal transport and stores receiving and issuing are common to many companies, and blue printing and typing are comparable over the whole range of industries. (Chart 4)

This concentration on processes and components, rather than on products, is more in keeping with the activities of departmental supervisors and foremen and is more easily understood by them. Over the past three years, therefore, this aspect of productivity assessment has undergone considerable investigation, and several sub-committees of the Institution of Production Engineers and the Institute of Cost and Works Accountants have issued Reports on process comparison.

The work carried out to date has been under four main headings :—

1. Time Standards.
2. Machine Utilisation.
3. Office Efficiency.
4. Presentation of Cost Information.

Time Standards

Early investigations proved that manufacturing costs or piece work prices are not satisfactory as standards of measurement. Time Study standards, on the other hand, were shown to be the most suitable. The suitability of time is appreciated when it is realised that a unit of time is a universally accepted standard, making possible even international comparisons. So that time standards can be effectively used to measure and compare productivity, our basic conceptions of Time Study must be defined and we must have agreed practices and procedures. (Charts 5a, 5b)

In many instances, Time Study rates are used not as a standard of measurement but as a basis for some payment by results scheme. The Committee found that in these circumstances the basic time for doing the job was often so loaded with allowances that it was useless for comparative measurement. Moreover, where these Time Study rates had been in existence for long periods they no longer represented the work content of the job, but were simply records of what *had* been done rather than what *could* be done. (Chart 6)

Perhaps industrial management has introduced too much "padding" to Time Study standards to bolster up wages to an attractive level, instead of using Time Study to set a high standard of expectancy as the incentive to reward for increased productivity. Nevertheless, it was found that with those companies using Time Study standards, a considerable degree of internal measurement of productivity was being achieved. Action on the recommendations contained in the Interim Report on the Measurement of Productivity, issued in December, 1949, could make inter-factory and industry comparison of productivity effective.

Machine Utilisation

Another aspect of productivity soon brought to light by the Committee's investigations was the question of plant utilisation. The extent to which the capital equipment is actually used can be a major factor in the level of productivity. There is, of course, need for a simple and accepted method of measuring and presenting machine utilisation efficiency. A survey made it clear that in general the standard of

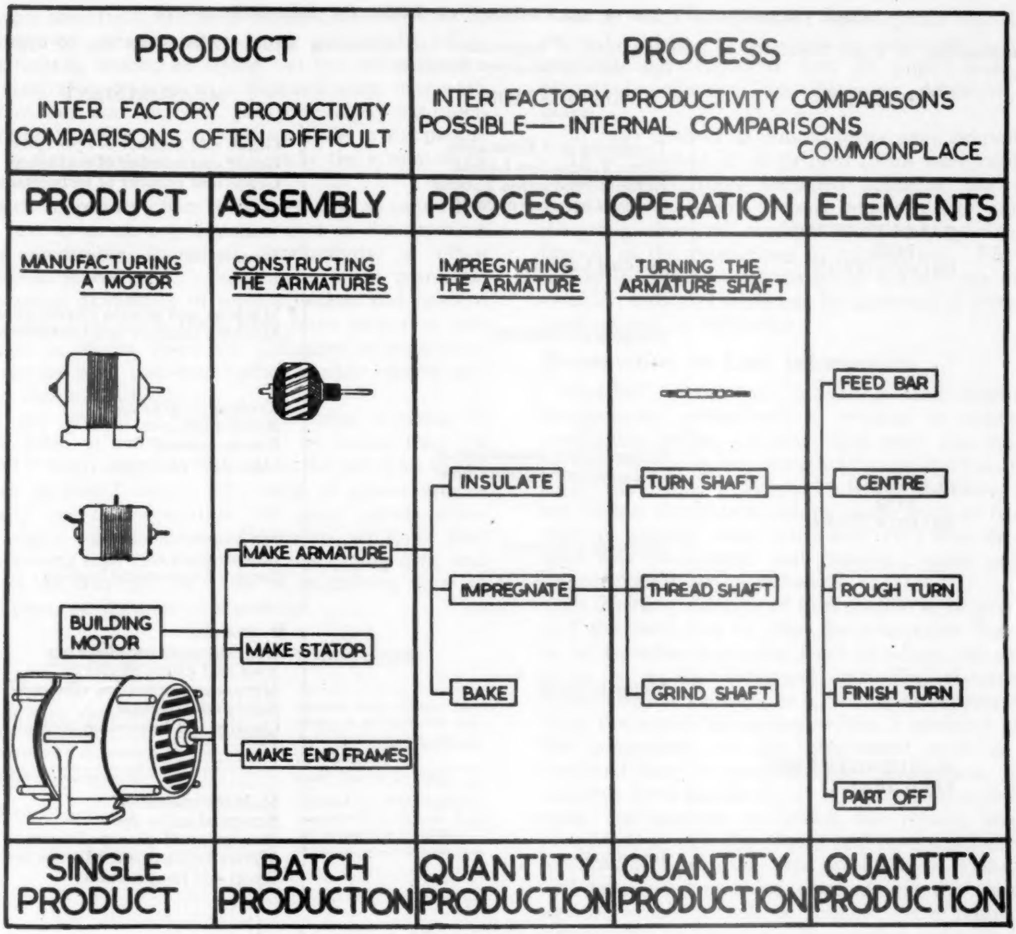


Chart 4

THE ESSENTIAL FUNCTIONS OF TIME MEASUREMENT

Function : To be responsible for providing a standard of measurement for all functions—to apply these time standards—to investigate and report on the results measured.

In order to carry out these essential duties it is important that the Time Study Department embraces two principles :—

(1) It must be built up on solid and known foundations.

(2) It must inspire unquestionable confidence from those who will measure by it and those who will be measured.

1. It must be built up on a solid foundation

Standard of impartial judgment—unbiased and without fear or favour.
Upheld by Management and Company policy.
Methods used must be unquestionable—open and consistent.
Personnel should be correctly selected and with the right attitude of mind.
Training to analyse, investigate and seek the facts.
Provide a unit standard of measurement.
Use the standard of measurement as a financial incentive to direct workers only when all other functions are efficient.

2. It must inspire unquestionable confidence

Provide a standard of measurement which all will respect in spite of other inconsistencies.
To be relied on by those who measure by it and those who are measured with it.
It must never be used to exploit and speed up direct operators.
Both management and workpeople must appreciate its interpretations and limitations.
Method used must be understood by all and not cloaked in complications and mystery.
Must respect and make use of the assistance and knowledge of other departments and individuals.

Ideal : A recognised National standard of procedure for investigating and recording efficiency—and a unit of quantitive measurement.

Chart 5(a)

TIME STANDARDS AS A MANAGEMENT TOOL OF MEASUREMENT

The application of Time Standards in setting targets of expectancy and measuring actual achievements can be applied to four main production functions :—

FUNCTION	APPLICATION	MEASUREMENT
CALCULATIONS FOR PRODUCTION	Tendering and Estimating Direct Production Labour Indirect Production Labour Service Department Staff	Grade and number of operators Grade and number of craftsmen Grade and number of technicians
	Building Capacity	Floor space requirements
	Equipment Capacity	Machine and process classification Machine capacity and commitments
PLANNING FOR PRODUCTION	Delivery date commitments Manufacturing programme	Tooling programme Batch quantities Process routing Operation planning
	Production Control	Machine work loading Labour work loading Service Department loading
MANUFACTURING EFFICIENCY	Methods Study	Operator training efficiency Tool and gauge efficiency Motion and operation efficiency Safety effectiveness Quality and Inspection control
	Investigation	Machine utilisation Non-productive time Heating and lighting efficiency Service Department effectiveness Scrap and re-operation
COST CONTROL	Factory Costs Manufacturing Costs	Direct labour standard costs Production Service costs Budgeted costs Material standard costs Capital investment

Chart 5(b)

plant utilisation in British industry is very low—often in the region of only 40 per cent. Low utilisation may be at the root of our inheritance of old mills and obsolete factory machinery, and our lack of investment in modern productive equipment.

The maximum time for which a machine can be available for production is twenty-four hours a day for seven days a week, but except for industries working on a continuous process, comparisons based on this maximum would be unrealistic. However, where the capital investment is high, two and three shift working contributes to lower costs and higher productivity. High labour and supervision costs are more than offset by the savings in general overheads.

It is reasonable to expect that where any one piece of equipment has involved an investment of £5,000, the machine utilisation should be calculated against a total of 100 available hours a week. In the Joint Committee's Report published in September, 1951, under the title "Measurement of Productivity—Applications and Limitations", recommendations are put forward on the ways and means of setting standards and measuring the effectiveness of machine utilisation. (Charts 7 (a) and 7 (b))

Office Efficiency

In far too many companies, the offices are looked upon as necessary evils and are classified under that dark cloak of "indirects". I much prefer to look on office organisations, not as inefficient indispensables, but as production service departments. In fact, the office of even a batch production factory or a jobbing shop often has a routine procedure that can be laid out on a real flow line basis. Perhaps we in

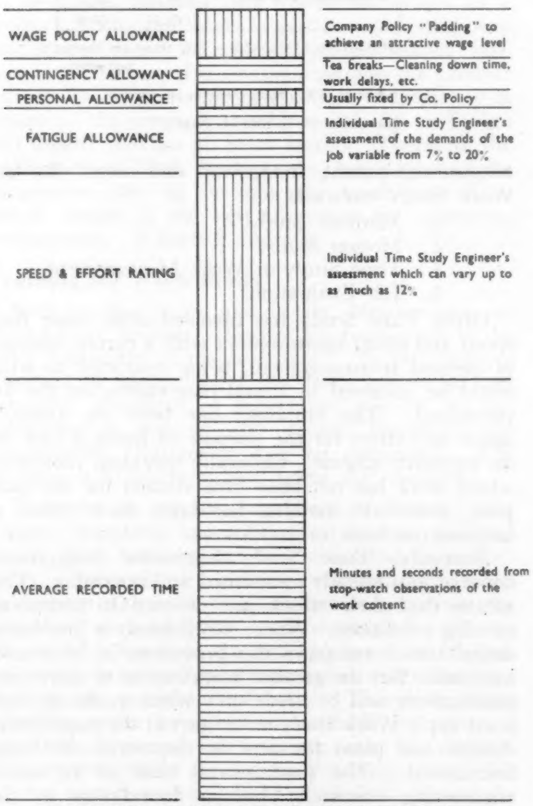
industry have built too many totally enclosed ' hole in the corner' private offices and water-tight office departments, instead of laying out our offices in the sequence of operations to a planned work flow with no partitions and barriers. It is easy to pay too much attention to office systems and too little to the people and to the conditions that will make the system work effectively.

As the necessary office work is equally as important and just as much a production cost as the machine shop operations, increased productivity in office processes is essential. Progressive office managers have taken advantage of mechanisation and modern equipment and while these have often increased production in offices, there are unlimited opportunities to increase both individual office worker output and office machine utilisation.

If the process of typing—the most common of office jobs—is examined, it will be found that the actual " machining time " is about 40 per cent. of the " floor to floor " time. This state of affairs applies equally to the operation of most other office machinery. As Production Engineers, we know that the element that produces is the machining time and that if we increase the ratio of machining time to total time, we increase productivity.

Chart 6

THE TIME STUDY INGREDIENT OF AN INCENTIVE SCHEME



BY HOW MUCH DO YOUR INCENTIVE SCHEME STANDARDS VARY FROM THE AVERAGE RECORDED TIME?

As a result of a recent investigation of all the printed forms in a certain company — which incidentally, considered that its paper work was reasonably efficient—the following decisions were taken :-

(a) 9 per cent. of its printed forms were deleted, and
(b) 12 per cent. of its printed forms were modified.

The modification included bringing the forms up-to-date to meet present requirements and re-designing them to conform with the spacing and line-up of the typewriters in current use. The total saving in cost was calculated at £4,500 *per annum* —which indicates what can be achieved in increasing productivity in the office.

Presentation of Cost Information

Another aspect of measuring and comparing productivity, particularly in relation to indirect or production service efficiency and costs, was found to be the recording and presentation of information at supervisory level. When budgeted overhead costs are broken down to standard items (such as heating, lighting, cutting tools, lubricants, etc.) that the foreman can understand and compare, quite amazing improvements can be achieved.

In deciding the type of information to be presented and the form it is to take, the two points that have to be considered are the level at which the information is to be presented and the purpose the information is intended to serve. Such reports should show the actual attainment within a specified period, the comparison of the attainment with a fixed standard and an analysis and explanation of the variance from standard. It is imperative, in deciding upon the manner in which the reports shall be presented, to seek the advice and co-operation of the foreman or supervisor. He must also be consulted—and agreement must be reached—on the standards against which he will be judged. Any report of a supervisor's or foreman's department must deal only with those things that he can control or influence.

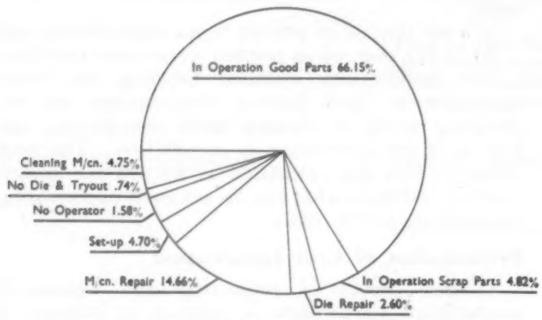
Those responsible for compiling the report of attainment against the set standard should always be in direct touch with the recipient of the information, so that the activities under review can be fully discussed, and so that the user of the information can be fully conversant with the meaning and significance of the facts revealed. Supervisors and foremen should receive the reports about matters under their supervision and control before the same information is submitted to their top management.

Wherever possible, information in the reports should be presented in the form of charts or graphs, tabular statements and also in narrative form. It is important to ensure that the report is addressed to an individual and that it refers to him by name, and not merely to a departmental number or definition. Similarly, the names of persons to whom copies of the report have been circulated should also be included. Industrial management should never be accused of issuing *post mortem* reports rather than current information. With reports more than anything else it is easy to make them complicated and so difficult to make them simple. (Chart 8)

CHART 7 (a) DIECAST DEPARTMENT

REED-PRENTICE (TYPE 3G) MACHINE UTILISATION FOR W/E: 13.7.52

ONE MACHINE



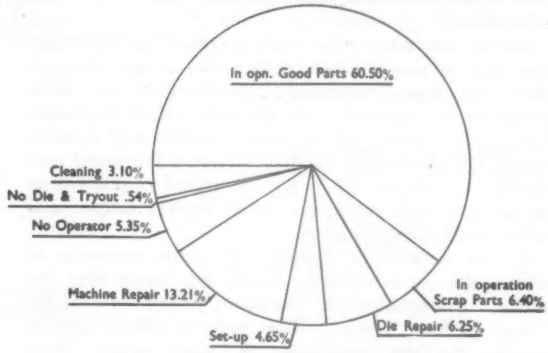
Description	Hrs.	Percentage
Cleaning Machine	6.04	4.75
No Die & Tryout	.94	.74
No Operator	2.00	1.58
Set-up	6.00	4.70
Machine Repair	18.62	14.66
Die Repair	3.30	2.60
In Operation Scrap Parts	6.00	4.82
In Operation Good Parts	84.10	66.15
	127.00	100.00

CHART 7 (b)

DIECAST DEPARTMENT

SUMMARY OF MACHINE UTILISATION FOR W/E: 13.7.52

16 MACHINES



Description	Hrs.	Percentage
Cleaning	60.49	3.10
No Die & Tryout	10.58	.54
No Operator	104.25	5.35
Machine Repair	257.80	13.21
Set-up	90.60	4.65
Die Repair	122.63	6.25
In Operation Scrap Parts	123.15	6.40
In Operation Good Parts	1187.00	60.50
*	1956.50	100.00

UTILISATION STANDARD = 112½ Hours per Machine * per week.

* Average of 9.75 hours Overtime per Machine.

Issued by :—W. G. Neill (S. Baker.)

It may be thought that I have drawn a long bow by including in the measurement of productivity the question of the presentation of cost information. I have been substantial—as the accompanying chart achieved through the improvement of this factor have been substantial—as the accompanying charts will indicate. It is also significant that the Report of the Joint Committee entitled "Measurement of Productivity—Applications and Limitations" pays considerable attention to this subject.

Work Study as a Basis for the Measurement of Productivity

For the past eighteen months, a team of the Joint Committee has been carrying out investigations and preparing a Report on the use of Work Study as a basis for the measurement of productivity.

Quite early in its investigations the team was confronted with problems concerning the scope of its enquiry and the terminology in use in industry. Originally set up to devise a system of training for Time Study as a factor in measuring and improving productivity, it became clear that "Time Study" inadequately described the range of activities required to be covered by the investigations. Work Study, on the other hand, which has wider applications than those connected with payment by result schemes, and the introduction of which in a company will help Production Engineers and Cost Accountants build up accurate figures of production costs in labour and finance, more accurately described the subject to be studied. The main function of Work Study is to improve design, methods and operating conditions and to determine work standards. Design, methods, and conditions include not only designing for production and detailed processes, but also the quality of the product, the training of workpeople, the flow of material and all the factors that influence output, equipment, manpower and costs. In fact Work Study embraces :-

1. Methods Study,
2. Motion Study,
3. Time Study or Work Measurement,
4. Job Evaluation.

Often Time Study has involved little more than speed and effort measurement with a certain amount of method re-arrangement, being restricted to what could be achieved by visual observation on the job concerned. The emphasis has been on assessing speed and effort for the purpose of fixing a rate for an incentive scheme. Generally speaking, moreover, where work has not been time studied for this purpose, practically nothing has been done either to improve methods or conditions.

Normally, Time Study Engineers' assignments concern jobs already established and operating. This means that their efforts are devoted to correcting existing conditions. Where Work Study is first introduced into a company this procedure is, of course, inevitable. But the greatest contribution to increasing productivity will be made only when qualified engineers apply Work Study techniques at the stage where designs and plans for new developments are being formulated. The fundamental basis of all sound engineering economics has its foundation in the design of the product ; in fact the drawing board is

To : All Superintendents

DIRECT LABOUR HOURS
DEPARTMENTAL EFFICIENCY
FEBRUARY, 1952

Supervisor	Dept. No.	per cent. Efficiency against Standard	Efficiency Rise/Fall January—100
Mr. Smith	06 Tubes	100.3	112.6
Mr. Jones	11 Diecasting	94.9	100.7
Mr. Robinson	13 Fettling	100.4	109.0
Mr. Smith	14 Bakelite	95.6	98.1
Mr. Brown	15 Grinders	100.5	103.7
	19 Capstans		
	43 Drills		
Mr. Wilson	20 Presses	94.4	100.0
Mr. Kent	21 Enamel	92.7	100.1
Mr. Creme	22 1st Floor Assembly	99.0	107.2
Mr. Sanders	24 Automatics	100.9	101.3
Mr. Kent	25 Polishing	99.2	99.1
Mr. Dean	26 Plating	94.5	94.9
Mr. Parker	27 Bags, Brushes and Cartons	102.3	108.1
Mr. Bailey	28 C. Tool Assembly	103.2	110.8
Mr. Hutchinson	42 Electric Polisher	89.3	99.8
Mr. Baker	44 Armatures	98.7	107.5
Mr. Howard	47 402 Assembly	97.9	109.4
		97.1	103.9

Copies to: Sir A. B., H. J. K., L. M .S., S. T., W. B., O.M.H., D. R. W., P. C. J.

Chart 8

the cradle of production costs. I would venture to go so far as to state that unless the design of a product is efficient from both the functioning and production points of view, then no matter how perfect the factors of manufacturing are, the product will not be an economic proposition. Superiority in design of the product, machine tool, jig or fixture will usually outclass all other factors. Therefore the application of Work Study at the design stage of the component, the jig or tool, the machine tool or simple fixture is the best insurance for increasing productivity. (Charts 9 and 10)

Training for Work Study

Both in this paper and in the Measurement of Productivity Reports, reference has been made to the term "standard of measurement." In fact, once a standard of measurement has been arrived at and accepted, standards of expectancy can be set up, achievements against the target recorded and productivity attainments can be compared. The problem is to arrive at and define the standard.

Everyone in industry has heard of "loose" and "tight" standards and many of us have experienced them. Both extremes can be detrimental to productivity. For example, incorrect standards can result in delivery dates not being maintained, because the complete work-load was under-estimated. Or, to take another example, the excessive purchase of plant can result from inaccurate assessment of the machine loading or machine utilisation. Therefore, more attention must be given to methods by which a standard time and performance can be assessed. This almost wholly depends on the training and skill of the person whose job of work it is to set the standards of measurement.

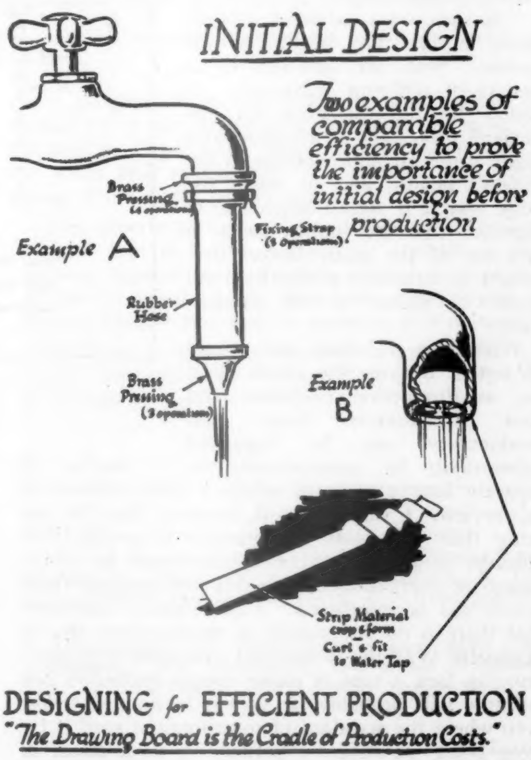


Chart 9

The adequate provision of the right kind of training for Work Study is a matter of considerable importance to industry. Many progressive companies have already set up their own Work Study courses for top managers, supervisors, shop stewards and craftsmen. But more widespread facilities and a commonly accepted system of training depend on the support of industrial managements. Once top managers are convinced of the value of the applicataion of Work Study in their own organisations by being conversant with its practice, understanding its application and appreciating its use as a tool of management, a scheme of training on a national scale becomes practicable.

A Report on this whole subject of the application of, and training for, Work Study for the purpose of measuring productivity has just been published by the Joint Committee.

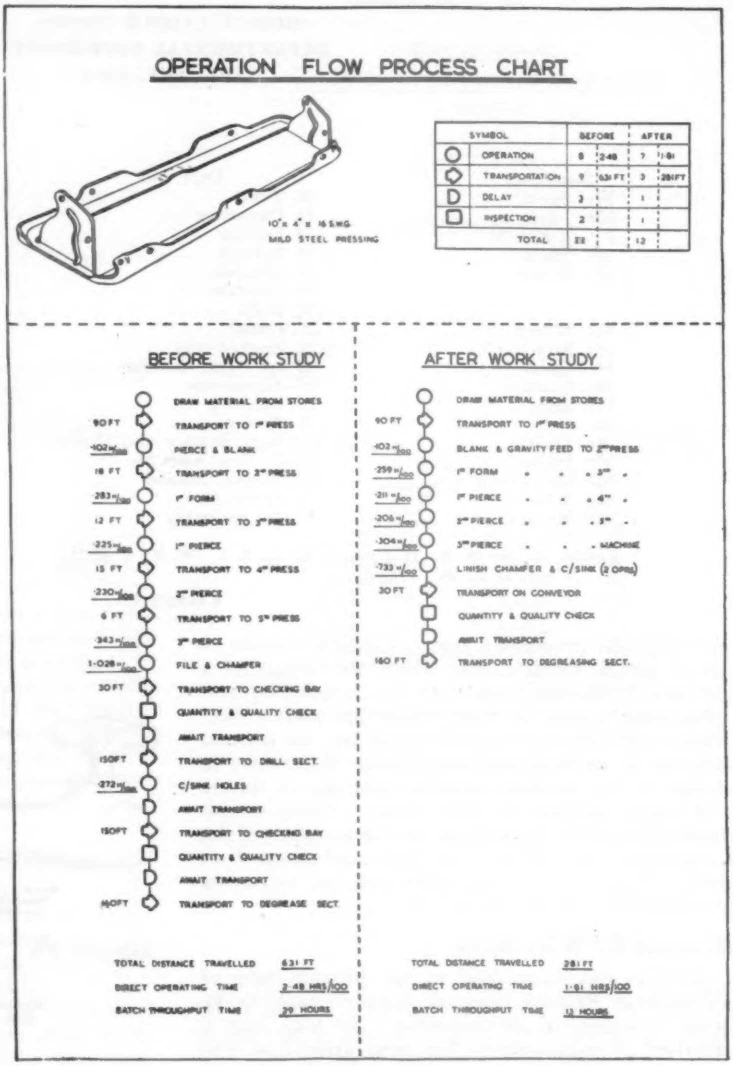


Chart 10

Conclusions

One of the Joint Committee's Reports says this of the problem of raising productivity:

"In some ways industrial productivity is like the health of the nation; both are affected by a variety of different influences. It would be difficult even for the medical profession to attribute to a single cause an improvement in the nation's health, and in much the same way it is almost impossible to stipulate that an improvement in any one of the many factors concerned in industrial production will result in higher overall productivity."

With this I think we would all agree, but on the other hand we, as Production Engineers and Cost Accountants, know that productivity can be improved substantially by concentrating on a number of separate factors, some of which I have outlined in this review. I am convinced, however, that the one thing that will make an increase in productivity possible, is a standard of measurement by which targets of expectancy can be set and against which results can be compared. I am equally convinced that there is no one system of measurement that is applicable to all the factors and conditions of production; in fact, a type of measurement applied in one industry will probably be useless in another. Yet even where the standard of measurement used is far from being scientifically perfect, if, as a result of applying that standard, remedial action is taken, the improvement in productivity could be both immediate and lasting.

As an example of the results that have been achieved by applying standards of measurement to a number of different factors involved in productive efficiency, I can illustrate that in one factory it has been possible to show a progressive increase in productivity of 30 per cent. per annum for the past four years. I would make it quite clear that this achievement has not been the result of any single factor, but of the considerable concentration on different factors throughout the whole organisation with standards of expectancy, from those set by the Chairman of the Company down to the targets set by the foreman in the shop, operating throughout. (Charts 11 and 12)

PRODUCTION, MANHOURS & PRODUCTIVITY.

BASED ON AV. 1946 → 100

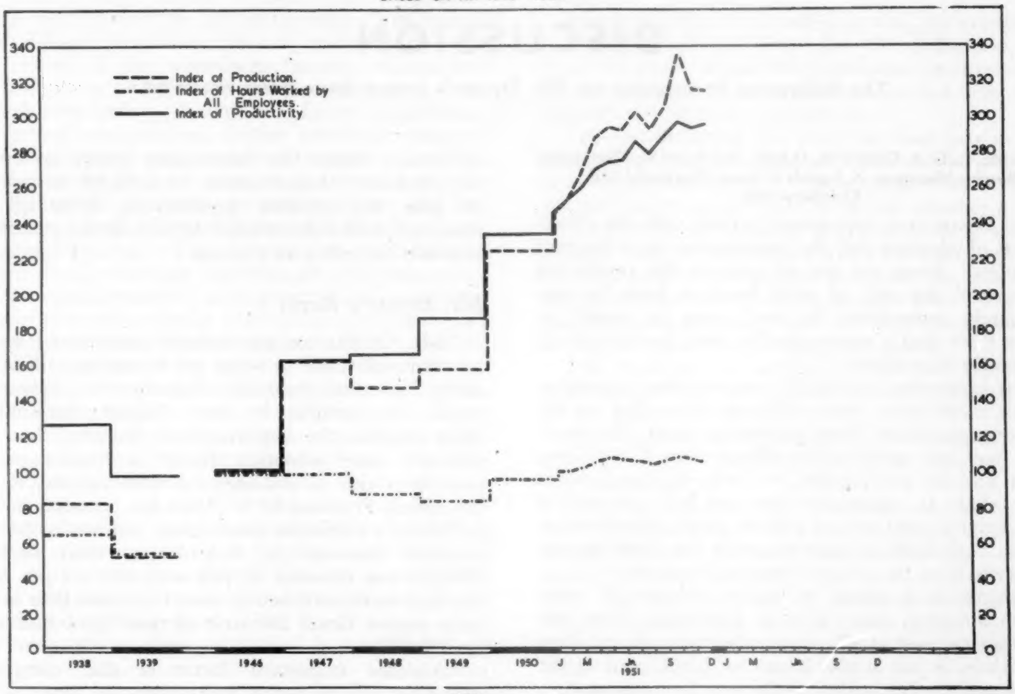


Chart 11

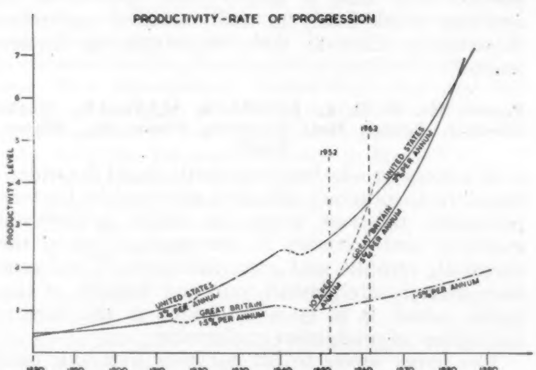


Chart 12

The main headings under which this improvement in productivity can be allocated are as follows :—

	per cent.
Product Design	25
Utilisation of Material	15
Capital Investment in Plant ...	20
Improved Tooling and Methods ...	15
Improved Floor Layout & Material Handling	12
Training of Staff—Aptitude and Effort	13
	100

The programme of improvement also resulted in productivity per square foot of floor space being increased by 45 per cent. Moreover, the combined cost of scrap and re-operation was reduced to 1.5 per cent. of the direct factory cost.

This experience suggests that it seems reasonable to suppose that in British industry as a whole, a progressive increase in productivity of 10 per cent. *per annum* is possible. At this rate, productivity in Britain could equal that in America in ten years.

What an invigorating standard of expectancy this makes for every Production Engineer and Cost Accountant !

References

1. Interim Report on Measurement of Productivity. Sole Distributors: Macdonald & Evans, Publishers, 8, John Street, Bedford Row, London, W.C.1., price 1/6d. post free.

2. Measurement of Productivity — Applications and Limitations. Sole Distributors: Gee & Co. (Publishers) Ltd., 24-28, Basinghall Street, London, E.C.2., price 2/- post free.

3. Measurement of Productivity — Work Study Application and Training. Sole Distributors: Gee & Co. (Publishers) Ltd., 24-28, Basinghall Street, London, E.C.2., price 5/- post free.

DISCUSSION

The following comments on Mr. Dyson's paper have been received :

From Mr. C. E. A. GRIFFIN, O.B.E., M.I.Prod.E., Divisional Works Manager, S. Smith & Sons (England) Ltd., Cricklewood.

Mr. Dyson very appropriately deals with the effectiveness of what we call the non-producing or indirect functions. Since we are all part of the producing effort, and the cost of each function finds its way ultimately somewhere in total costs, it would be better if we had a more suitable term for this side of our production effort.

It is interesting to note his constructive comments in this connection, since emphasis is so often on the effectiveness of the direct producing units. So much study has been made of the effectiveness of the direct effort and by comparison, so little on the indirect side, that it seems we are not fully measuring productivity until we are able to check the effectiveness in both fields to approximately the same degree, particularly in the scope of motion economy.

Industry as a whole, by which I mean all ranks within industry, seems slow to appreciate fully the fact that the cost of all consumables and all ancillary operations, is just as much part of actual costs as the wages paid to the worker at the bench or machine.

During recent years industry has spent large sums on devices to increase efficiency at the bench or machine, while trying at the same time to reduce or eliminate fatigue; trying, as Mr. Dyson says, "to make two ears of corn grow where only one grew before"; trying also to offset some of the cost of higher money wages, greater security and more leisure, which we as a nation have been trying to get all at once. Truly this is a task of considerable magnitude, which surely should be shared by all.

A study of motion economy alone in the whole field of indirects, involving much less capital expense, would level up the effectiveness of the indirects to something near the ratio of the measured directs, and thus make its effective contribution to the whole.

Thus it becomes clear that the recommendation in Mr. Dyson's paper under the heading, "Presentation of Cost Information", is an indispensable step towards creating a total cost-conscious attitude of mind at supervisory shop level.

It is certainly true, as Mr. Dyson states also, that amazing results can be achieved by the presentation of accounting information in understandable terms, on a budgetary basis at foreman level, giving each Departmental Head the responsibility of his own "departmental housekeeping".

When we have all applied the same scientific and enquiring attitude of mind to all functions of the industry with which we are engaged; when we look upon all ancillary operations as part of the flow lines; when supervision at all levels uses all the classes of labour within its control to effective optimum; when the Accountant teams up on the factory floor; then it seems we shall be on our way to gain the greatest productivity from all our resources, and will certainly be in a better position to measure the effort as a whole.

Mr. Dyson's Reply :

" Mr. Griffin has particularly commented on my frequent reference to what are normally called " indirect " or non-productive departments. When one reads the article in the August Westminster Bank Review, the importance of realising that considerably more attention should be focused on the non-direct side of industry becomes significant. In this article Professor G. C. Allen has occasion to refer to Britain's industrial production and states that the probable increase in output per man between 1938-51 was between 12 per cent. and 15 per cent., but that statistics recently issued indicate that in this same period Great Britain's clerical force had risen by 850,000.

" Another important factor is that companies operating job or batch production on their actual product may have a much wider opportunity of applying Work Study to their technical and office departments than to their manufacturing departments."

From: Mr. B. G. L. JACKMAN, M.I.Prod.E., Works Director, British Heat Resisting Glass Co., Bilston, Staffs.

As a member who has consistently urged the widening of the Institution's activities, and one who has seen personally the vast scope for skilled professional engineers and scientists in the organisation of the chemical, ceramic and glass industries, I welcome very strongly the general tone and breadth of this paper, which is in no wise limited to the narrow conception of production engineering.

The paper serves to lift our eyes from our own day-to-day problems to the broader horizons of national and international productivity, and sets a stimulating target for British industry in its efforts to overtake and better the rate of productivity increase at present operating in the United States. At the same time, it clearly shows that such a national trend can only be the sum of many hundreds of thousands of small individual contributory instances, many of them costing nothing in capital re-equipment.

The details given of the sizes of industrial firms and their employees in both American and British industry, show how closely the relative pattern remains and leads me to criticise in one respect the points made by Mr. Dyson on the rate of productivity increase. Surely, if Britain can increase

productivity by 10% per annum (and in many cases I am sure it can), it is logical to assume that the Americans with a similar structure and proportion of large and small firms can do the same if the spur is there. To my mind we shall only catch up by 1962 as a nation, if the Americans become self-satisfied and complacent—from my own experience a most unlikely eventuality. I think that for far-sightedness, intelligence and integrity, British industrial management at director and technical executive level is superior to that in any other part of the world, but the application of techniques and processes and the necessary attitude of mind to get on with the job are sometimes lacking. They must never be lacking if we are to win through individually and nationally, and the measurement of productivity in all its aspects is a tool or a series of tools to help stimulate ideas and thought, and analyse problems and then by synthesis to build up, in due course, the solutions and improvements in the application of those techniques.

Much attention has been focused recently on the first two of Mr. Dyson's four points on Productivity Measurement—namely Time Standards and Machine Utilisation, to which I would add a third not mentioned, namely—Material Utilisation, but far too little time has been spent in considering the problems of office efficiency, which is largely non-existent in many industrial undertakings, and the presentation of cost information in understandable form at departmental and operator level. Mr. Dyson does well to focus attention on these points and I would conclude this brief contribution with a plea to all directors and managers to study very seriously all the psychological and detailed aspects of indirect personnel, including executive officers, and thereby ensure that every single person from the shop floor downwards (I consider the shop floor senior to most administrative and office departments) knows their own and the Company's targets, in order to contribute in full and equal measure to the achievement of same.

In 1763 Dr. Johnson remarked to Boswell:—

> "that experience built upon the discoveries of a great many minds was always of greater weight than the mere workings of one mind, which can do little of itself."

How true is that remark today, nearly 200 years later, and what dividends will result if the realisation of this truth is kept uppermost in the minds of all people involved in industrial management today and actions taken accordingly.

From: Professor J. V. CONNOLLY, B.E., F.R.Ae.S., M.I.Prod.E., College of Aeronautics, Cranfield.

Many of my readers will remember the days in which their struggle with the calculus was aided—at any rate, given a new lease of life and inspiration—by the little book, "Calculus Made Easy", written by the mysterious figure, Sylvanus P. Thompson. All his words of wisdom have passed away save only his ancient Simian proverb: "What one fool can do, another can". That is doubtless what Mr. Dyson means by "expectancy".

I hope that the word itself does not gain acceptance just as sincerely as I hope the idea behind it does. As to the word—standard of performance is sanctified by some sound usage and also sounds a little more scientific ! May we not stick to it?

The soundness of the diagnosis that productivity is a "state of mind" rests on this fundamental idea of a standard or a target. It is extraordinary that in the days when we are able to discuss whether a horse has a chance of winning the 3.30 with 9 stone 2 pounds "up", or whether a runner will beat 10 seconds for the hundred metres, we are quite vague as to the man-hours we can afford to do most jobs. We have our standards precisely fixed for our sports, but not for our survival as a competitive nation.

The problem of setting a standard purely for operations is still severe, even if we confine ourselves to one class of industry.

Inter-industry and international comparisons are correspondingly difficult; they are, however, still worth attempting.

They show that on global figures there is a ratio of two to one in favour of the Americans and this means that this same ratio exists between the best performances here and the less competent ones. We can show that in the good organisations that have set proper targets, and provided the means to attain them, performances (however measured) are equal to those attained across the Atlantic.

One of the great complications in making comparisons is the profound effect of quantity, particularly the continual repetition or cumulative quantity. It has been discovered that the exponential law for reduction of man-hours with numbers produced—first predicted by T. P. Wright in 1936 for aircraft and engines—applies well to a large range of other products. Space does not permit full discussion of this phenomenon; briefly expressed by the simplification "each" doubling of the cumulative quantity reduces the man-hours by 20%—sometimes called the 80% law for this reason.

It is clear that if we neglect the previous productive history or predict ahead without having proper regard for this possibility, considerable errors are likely. This reduction alone demands that we should embrace the basic philosophy of setting continually higher standards, "expectancies" or targets. Failure to do this is not even equivalent to maintaining present productive effort.

Mr. Dyson's paper is an important addition to the literature of productivity and requires much study and deep consideration.

It is hardly a question that we *should* aim for the 10% increase shown in Chart 12; we have got to get this. Since many reliable Work Study measurements have given an average rating of about 40 to industry, it is quite a reasonable target.

NOTE: Comment is invited on papers published in the Journal. Contributions, which should be brief and to the point, should be addressed to the Editor, 36, Portman Square, London, W.1.

THE ADVENT OF AUTOMATIC TRANSFER MACHINES AND MECHANISMS

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Presented to the Birmingham Section of the Institution on 17th December, 1952

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Mr. Woollard has been concerned for many years with the development of flow production methods in the automobile industry. Following his apprenticeship to the Chief Mechanical Engineer of the London and South Western Railway, when he worked on the design and manufacture of steam rail cars and buses, he joined a firm of car component manufacturers as Chief Draughtsman, eventually becoming Assistant Managing Director.

In 1923, he joined the Engines Branch of Morris Motors Ltd., as Director and General Manager, and accepted his present appointment as Director of two of the Companies in the BIRMID Industries Group in 1936.

Mr. Woollard was President of the Institution of Automobile Engineers at the time of its amalgamation in 1947 with the Institution of Mechanical Engineers, and became first Chairman of the Automobile Division of that body. He is at present Chairman of Council of the Zinc Alloy Die Casters Association, a member of the Executive Committee of the Aluminium Development Association, Chairman of the Road and Rail Transport Association and also of the Mining Sub-Committees of that Association.

PART I.

THE coming of the automatic transfer machine is in the nature of a major revolution in method, but never was so important a change made with such a small flourish of trumpets. It is true that the technical press have faithfully reported progress, but in that modest fashion that prevails in such circles, while the lay press have paid no attention at all to the possibilities that are opening before us. Should this appear extravagant, it must be remembered that automatic transfer machines and mechanisms are the flowering of the flow production system—that handmaiden of mass production—which has done so much to provide and increase the amenities of civilised life. This paper is an attempt to sum up the present situation in regard to these machines and mechanisms and to forecast the probable future for this new development.

Admittedly the role of prophet is dangerous but, since the author has no interest to serve—save an insatiable curiosity about methods in which management and mechanism go hand in hand—it occurred to him that it might profit British industry to have someone, who could not suffer for his opinions, explore—in a philosophic manner—the remoter possibilities of self-operating machinery when carried to its logical conclusion.

All the makers of end products that are made in any considerable quantity must be interested in automatism applied to production; but most of them—even those who have embarked on this new venture—are somewhat dubious of the outcome. That is to say that, while acknowledging the technical possibilities, they are doubtful whether such methods are economically justifiable. The author trusts that the discussion on the paper will bring out both the hopes and the fears, so to throw a searching beam into the future of the automatic transfer machine and all that it entails.

It is not proposed to go into any great detail about the mechanism. That can be obtained from the references provided, but it is desirable to glance at the history of the development in order to appreciate how far we have come and in what direction we are going.

The automatic transfer machine—as we now know it—grew out of the flow production techniques which have been current for rather more than thirty years past. Flow production which is, of course, a particular aspect of mass production, had been a routine for several industries for many years before it was applied to end products based on engineering practice. These industries however were dealing with products that flow easily—those that were liquid or fluid. In the former were such things as oils, beverages, emulsions; among the latter were coal products, seeds, flours, preserves, etc. Textiles, newsprint, rolled and extruded metals, steel rails also lent themselves readily to flow manipulation.

Engineering products, unlike these, do not flow easily because of their hard unyielding nature; the varying and frequently awkward shapes of the components; the divergent character of the operations to be performed and the accuracy that is required in most engineering operations. Therefore, when engineering components were required in small quantities they were made in batches and travelled in to the view room for inspection between each operation.

A Logical Development

When the output of automobiles became considerable, the logical development of mounting the chassis on the axles and so making it mobile was a neat solution of an assembly problem. It was only a step from this to the assembly of cars on a conveyor belt and the assembly of components followed suit.

With the growth of output, it was seen that if the machines were placed in order of the operations they had to perform, a considerable saving of transport and of work in progress would result. Again a short step introduced the slide—the roller track; the belt and pendulum conveyor followed. Thus the stage was set for the transfer machine.

Transfer mechanism had also been known for some time in connection with some of the easy flowing processes. One, only, must suffice for this brief review. It was introduced some fifty odd years ago and was known as the Livingstone-Richards Auto-Mailing machine. When the author first saw this fascinating piece of mechanism it was folding, wrapping, gumming, sealing, addressing, franking (with stamps) and sorting for mail bags copies of *The Saturday Evening Post*. The magazines were stacked at one end of the machine and the mail bags were removed at the other; meanwhile no hand touched the magazines, the wrappers or the stamps during the whole process. This, it must be admitted, is more in the nature of a simple automatic assembly than of automatic machining.

The author's first acquaintance with large scale repetition machining in continuous demand was at Morris Engines (Coventry) Ltd., later to become the Engines Branch of Morris Motors Ltd. This was in January 1923. He had previously been speculating on the possibility of using a common frame to carry a number of machine heads for carrying out a series of operations. There were obvious advantages to be gained if this could be done. This was mentioned to Mr. Herbert Taylor (then Chief Engineer of Morris Engines) who referred to a paper that he had given some months earlier to the Institution of Production Engineers under the modest title of "Factory Planning".(A) From this conversation a hand transfer machine for the production of cylinder blocks was born. This ambitious undertaking was described at length in a paper by the author entitled "Some Notes on British Methods of Continuous Production".(B)

The cylinder block machine was 181 feet long, it weighed 300 tons and employed 81 motors with an aggregate of 267 H.P. The machine had a common frame of box section built of cast iron to which, on both sides, a continuous table was attached. The work piece was moved on this table from fixture to fixture and clamped by hand. The operations were performed by motor-driven heads which were attached to the main frame. There were in all fifty-three action stations; these included some hand fitting,

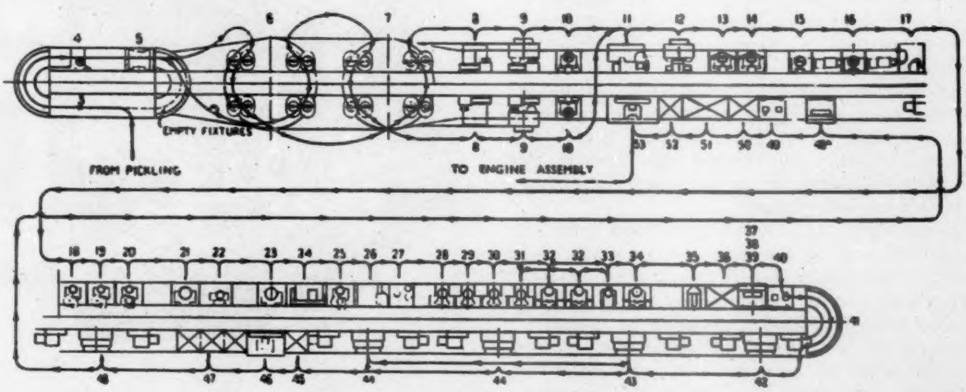


Fig. 1

Diagram of a hand transfer machine built for the Engines Branch of Morris Motors Ltd., in 1923/4. This was the forerunner of the modern automatic transfer machine.

two washing operations and the inspection stations. Twenty-seven men only were required to operate this group machine and this included the fitters and inspectors. It was a 50% saving in manpower. The time taken to machine the cylinder block completely —ready for the assembly track—was 224 minutes. The bearings were fitted and all studs driven. The time cycle was based on a four-minute period. (Fig. 1).

This group machine was a decided success. Machining costs were reduced very considerably while the operators received as much or more money as they did on their "individual" machines. The capital cost was certainly not more than a normal line of plant and this special machine outlived the engine for which it was designed—a section of it was still at work twenty-five years after it was first put into commission.

Following this two other "group" machines were built; one for gear box casings and the other for flywheels. These were provided with automatic work transfer and self-acting clamping mechanisms. The work was loaded, at the end of the machine, into a series of fixtures which travelled under the various operating heads. After passing through all stages the work was removed and the fixtures returned to the loading point. All the operations were controlled by a camshaft which ran the length of the machine. This set the cutting heads in motion and operated the movement and clamping of the fixtures. These, it would appear, were the first machines to be provided with automatic transfer and clamping systems. (Fig. 2).

Revival of Automatic System

Unfortunately, these mechanisms were over-complicated and in particular the electric devices were not reliable, so the heads were divided into individual machines and the automatic system was abandoned, to be revived in the U.S.A. some twenty years later. France and this country then followed and so to a smaller extent did Germany. We, in this country, did not go ahead so quickly as America because of our post-war financial position and, of course, we have not felt the labour shortage so acutely as they have in the U.S. Moreover, we have nothing like the home demand to spur our manufacturers to the same extent. So, obviously, we need to see through the glamour of mechanical achievement to the solid economic facts. Nevertheless, there are a fair number of automatic transfer machines in this country and a number are being built; practically all for the automobile industry.

Let us see how the automatic transfer machine differs from the normal automatic or automatic cycle machines. These latter, for the most part, operate on circular components. In any case the work-piece is held in chucks or vices, or in collets or mandrels. In due course the work-piece has to be released and re-set for the posterior operation; in a few cases this is done automatically. The series of operations is, of necessity, limited and the method has been applied only to simple and usually small components. Now in the automatic transfer machines there need be no limitations. They can deal with the irregular, bulky, heavy and ungainly components as readily as the normal automatic lathe handles the small neat circular components.

If desirable, it would be possible to undertake every operation on, say, a cylinder block, head, gear-case or similar component on a single automatic transfer machine. The number of stations need not be limited; the work-piece can travel bare, i.e. without a fixture; the work-piece can be presented to the tools in any position—square to the machine, at right-angles or at any other angle—the work-piece can be turned around or over by means of turn-table or "roll-over" units. If necessary, the work-piece can be loaded as raw material (e.g. castings) at the input end and delivered to the assembly line from the output end without human intervention.

It has not been, in this revival, the practice to arrange for one automatic transfer machine to do every operation on the larger components, but rather to arrange for a shorter series of operations to be carried out by a number of automatic transfer machines interspersed among normal pieces of plant. How this is achieved will be dealt with later; meanwhile let us examine the methods of moving the work-piece from station to station. The automatic transfer mechanism is quite simple. It may consist of a reciprocating bar fitted at one end with a spring-loaded pawl. On the out-stroke, the pawl passes

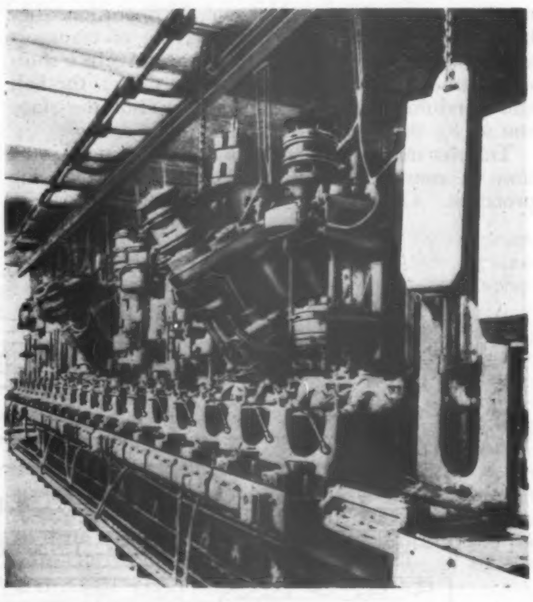


Fig. 2

The first automatic transfer machine was built for Morris Motors Ltd. by James Archdale and Sons Ltd., in 1924/5. It was designed to produce complete gear-boxes from the rough castings. It operated, transferred, located and clamped the work-piece automatically.

under the work-piece to rise when it is free to do so. On the in-stroke, the pawl carries the work-piece to the operating position. There may be one or more bars according to the size of the work-piece and the necessity of ensuring a proper presentation. Some of the Archdale machines have a chain mounted on two sprocket wheels. These rotate to give the out-stroke and in-stroke. The pawl lies neatly within the chain links. Some machines are fitted with a shaft having one or two fingers. The shaft is rotated through an arc which is sufficient to clear the work-piece on the out-stroke and to engage it on the in-stroke: an arc of 90° is usually sufficient. These methods are, of course, variations on ratchet mechanism. (See Fig. 16)

When the transfer bar makes its in-stroke, it carries the work-piece to a stop where dowels engage holes which have previously been drilled and reamed for the purpose. These dowels, which have a tapered lead, will locate the work-piece in accurate relationship to the cutting tools. This done, the work-piece is clamped by a pneumatic or hydraulic device. Sometimes it may be clamped to the ways on the bed of the machine or it may be lifted to top rails. The transfer bar will also be operated hydraulically or pneumatically and it may be controlled mechanically or electrically.

Package Type Mechanisms

Generally speaking, British machine tool builders are in favour of mechanical controls, due largely to the difficulty of diagnosing electrical faults. Electrical controls will come into favour when they are built and arranged so that troubles can be located as easily as they can be with mechanical movements, and when the electrical components are made as "package units"; readily removable and replaceable in only one—*right*—position.

Self-contained hydraulic mechanisms of the "package" type are in favour in America and this tendency is discernible over here.

As previously mentioned none of the larger complex components is made throughout on one automatic transfer machine; they are produced on a variety of machines in which automatic transfer machines are part of the set-up. The cylinder block line at the Ford Works at Dagenham includes some thirty-two machines among which there are seven automatic transfer machines. The blocks are handled manually —on roller track—from machine to machine, but on many of the one-station machines the work-piece is "acquired", loaded, located and clamped by self-operating mechanisms.

An excellent example of automatic transfer plant, performing a large number of operations, is provided by the "Archdale" four-stage multi-station machine installed at the engine factory of Morris Motors Ltd. at Coventry. On it are performed all the operations on the gearbox castings, for the Morris-Oxford car, that are subsequent to the external milling and main bore operations. (Fig. 3).

This machine, which is approximately 60 feet in length, replaces a line of 18 standard type machines which needed 13 operators to produce 750 gearboxes in a 44-hour week. Only four men are required to produce 1,600 boxes in the same time at 80% efficiency.

There are 20 machining and two gauging stations, plus a number of idle stations at which the gearbox can be removed for examination if desired. The locating rails which form the work table and, consequently, the machine heads are set at an angle of 45°. This makes it easy to get at all the mechanism and it is also helpful in the disposal of swarf.

The work-pieces travel bare through the machine. They are loaded on to a roller conveyor whence they are pushed on to driven rollers which carry them to the transfer mechanism. The transfer bars rotate through 90° to insert fingers behind the castings moving each, in turn, to its appointed station. The boxes are located by the main bores and the top cover face—the distance between the bore centres

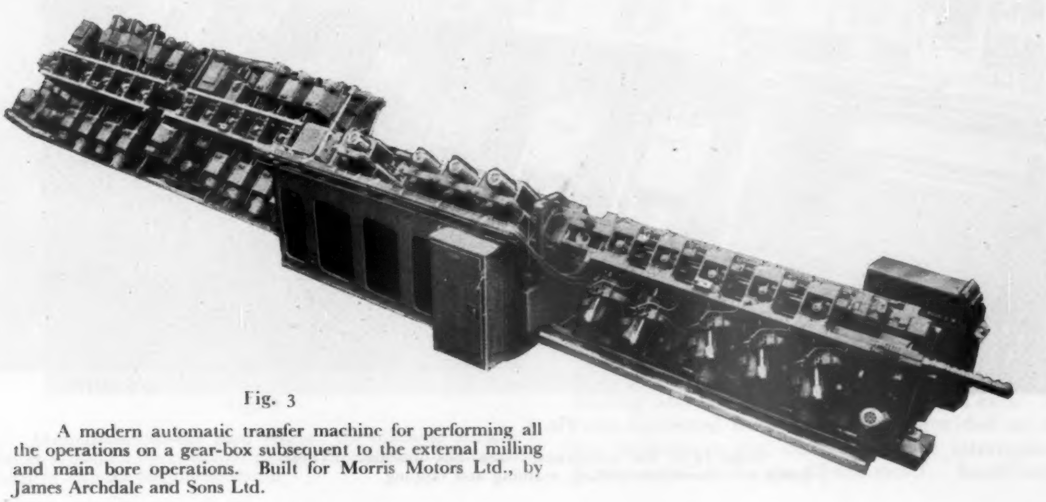


Fig. 3

A modern automatic transfer machine for performing all the operations on a gear-box subsequent to the external milling and main bore operations. Built for Morris Motors Ltd., by James Archdale and Sons Ltd.

and the face being an important dimension. Hydraulically operated plungers enter these bores and another mechanism ensures that the castings are held in the right position against the hardened steel locating rails. (Fig. 4).

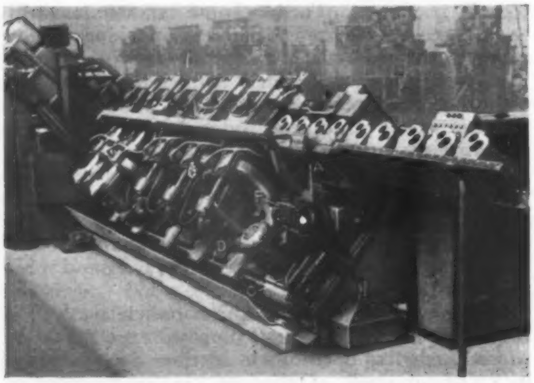


Fig. 4

Stage I of the auto-transfer gear-box machine viewed from the loading end. The five stations on this section are all concerned with milling interior surfaces.

All the machine heads have a cam feed with a positive return, with the exception of the tapping heads which are controlled by lead screws. Air blast clears the holes of chips before the taps are entered and there is a gauging station to ensure that all holes are drilled to the correct depth. Fixtures that rotate through 90° and return are a feature in the last operation sequences. The actual cutting speeds are kept low, so that long cutter life is secured and stoppages during working hours are virtually unknown from this cause. Quick release positive drive chucks of 'Morris' design are in use for holding drills, taps and reamers. (Fig. 5).

The machine stops automatically if there is a fault and red signal lights indicate the station at which the fault has occurred. If, for instance, a plunger fails to go home, if an electrical contact is not properly made or if the hydraulic system falls below the pre-set pressure of 250 lb. per square inch, the machine stops and signals for assistance. All operations are interlocked so that no movement can take place unless all is in order. Hand operated safety switches are provided at each station for the operators and a wandering lead with an "inching" switch is used for machine setting.

All service pipes and leads are exposed to full view and can be reached for service and maintenance without difficulty. There are no pits in the floor and overground shaker conveyors located on both sides of the machine carry the chips, which fall from the sloping surfaces, to portable bins placed at the end of the structure. The floor around the machine is remarkably free from chips and dust. (Fig. 6).

The development of this automatic transfer machine represents a triumph in co-operation between James Archdale and Sons Ltd, and the

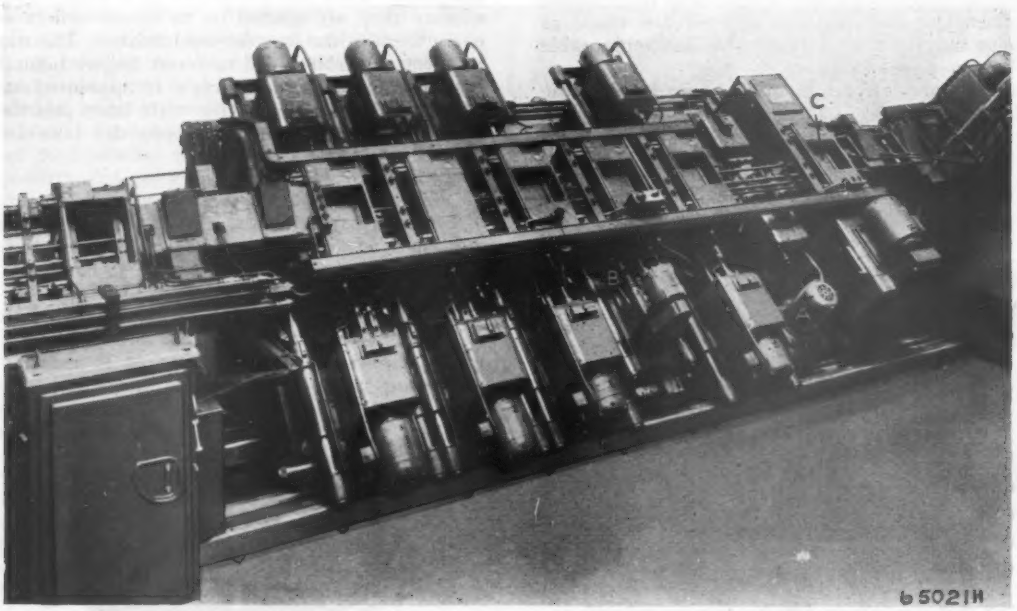


Fig. 5

Stage II of the auto-transfer gear-box machine. These heads are devoted to drilling, reaming and tapping.

Nuffield Organisation—in particular the Morris Engines Branch of Morris Motors Ltd., and Nuffield Tools and Gauges Ltd.(c)

Inter-operation Transfer

In the Ford factories at Cleveland and Dearborn, U.S.A., a large number of what are termed "automation" devices are in use for loading and unloading machines and for moving the buffer stock or "float" between the machines. These devices are not part of the machines but self-contained adjuncts to them. The means employed are similar to those in use on the automatic transfer machines—they consist of shuttles built into a frame which can operate as lengthwise or broadside movements. These manoeuvre the work-pieces into the required positions while turn-tables and "roll-overs" provide the proper orientation of the work-pieces to the tools. This mechanism converts a miscellaneous collection of machine tools into a complete automatic transfer plant, and it has the advantage that it permits the purchase of machine tools from a wide variety of makers. (Figs. 7 to 11 inclusive).

The details of the shuttles are largely standardised

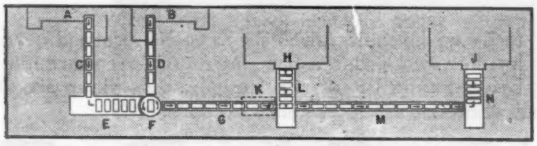


Fig. 7.

Diagram of automatic handling ('Automation') at Ford Motor Company, U.S.A. Cylinder blocks are taken from machines A and B by lengthwise shuttles C and D. Shuttle E takes priority over D to avoid interference at turntable F. Turntable F transfers blocks to lengthwise shuttle G. Then overhead shuttle K passes blocks to broadside shuttle L for machine H or via lengthwise shuttle M to broadside shuttle N for machine J.

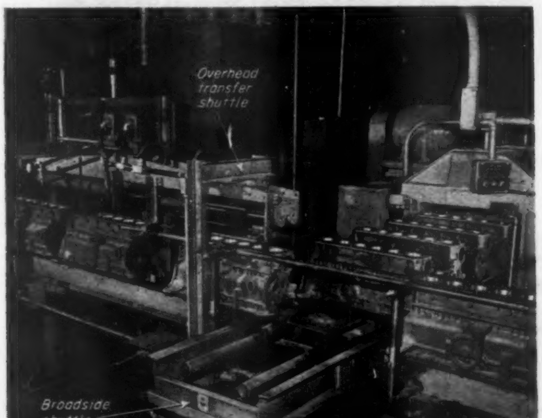


Fig. 8

'Automation' at the Ford Works. An overhead transfer shuttle is used for the cross-over where a broadside shuttle would interfere with the lengthwise shuttle.

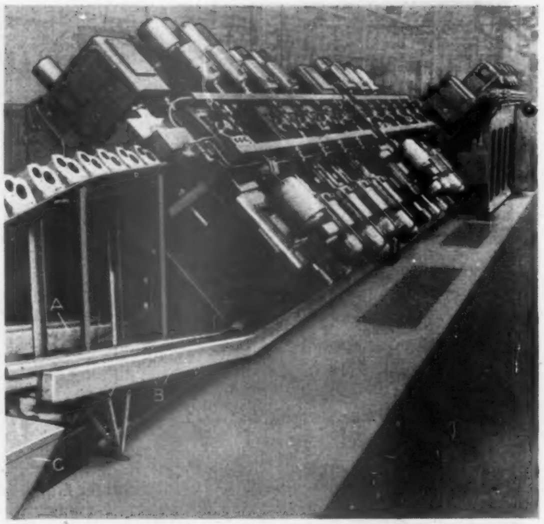


Fig. 6

Stages III and IV of the auto-transfer gear-box machine (drilling, tapping, spot-facing, etc.). Note the shaker conveyors A and B delivering chips into bin B.

but they can be varied as required. The framework that carries them is made up from standard structural steel. These shuttles feed into the orbit of the machine transfer bars, completely coupling up the external tracks with the mechanism that is built into the machine. The pushing speed of the transfer bars is about seven inches per second. It is kept low to avoid the inertia of the work-piece causing an over-run beyond the intended location.

The timing sequences are controlled in such a manner that parts can be marshalled for one short operation on one machine, or for a longer operation which for balancing purposes must be carried out on two or more machines. This control is exercised by electro-mechanical devices of various kinds. The movement of the work-pieces is selective according to the number of pieces at each station, priority being in accordance with the requirements of the situation—all this is automatic.(D) (Figs. 12 & 13).

Transfer machines need very long carcases which may be inconvenient in several ways. The "Renault" machine bases are built in sections, each of which can carry two heads on each side. In between these sections or units there is a bridge piece which, being spring mounted, can accommodate any out-of-alignment that may occur due to faults in setting-up or subsidence. The unit bases and the machine heads maintain an integral relationship. The transfer bars pass through the bridge pieces as well as through the bases. Thus, in one transfer line for a cylinder block, they have six bases with twelve operating stations and twenty-three heads. Other units provide loading and off-loading stations at each end. In all cases hardened ways or rails are provided on which the work-piece can slide; these are interrupted by "cut-aways" to scrape off the swarf. Swarf removal

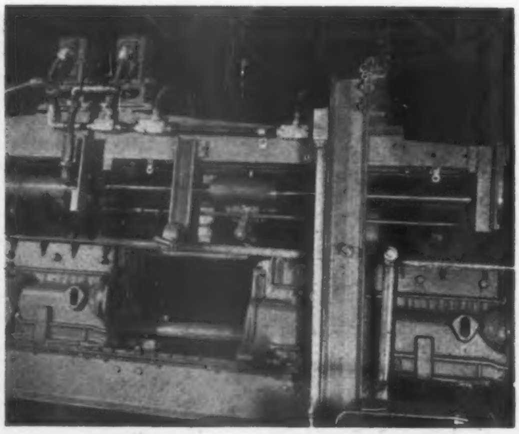


Fig. 9

A close-up showing the details of a lengthwise and an overhead shuttle. The overhead picks up where the lengthwise movement ends.

is a problem; in some cases a screw conveyor is used, in others a belt conveyor below floor level. Shaker conveyors are employed in the Ford U.S. plants. (Figs. 14 & 15).

There are two schools of thought in regard to the transmission of the work-piece through the machine. One holds that it is best for the work-piece to travel bare, while the other prefers that it should be mounted on a jig-plate or pallet. The advantage of this latter is that the dowel hole positions can be standardised in the jig-plate, so that any subsequent alteration does not involve a major operation on the machine locations. Against this is the fact that the jig-plates have to be cleaned of swarf and returned to the starting point. Sometimes the jig-plates may have

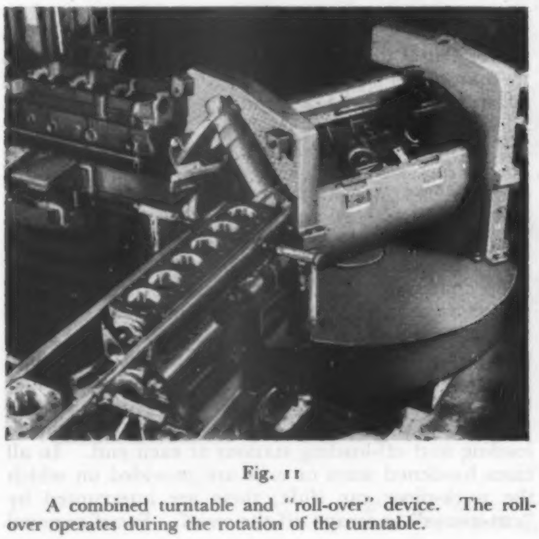


Fig. 11

A combined turntable and "roll-over" device. The roll-over operates during the rotation of the turntable.

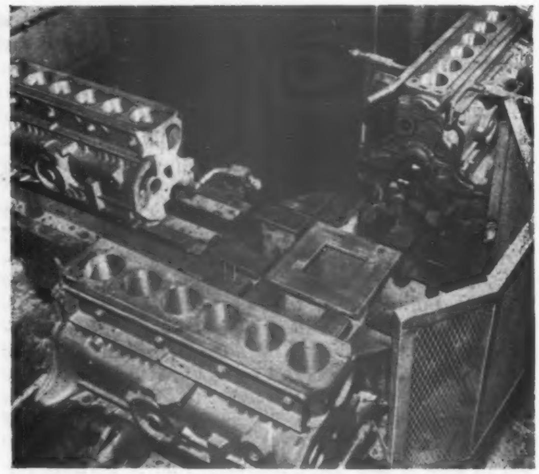


Fig. 10

A turntable device for transferring blocks, delivered broadside, to the lengthwise direction. The transfer bar can be seen in the bottom left-hand corner.

to be washed and unless they can be returned overhead or *via* a cellar, a fair amount of floor space may be wasted on the return line. The jig-plates are of

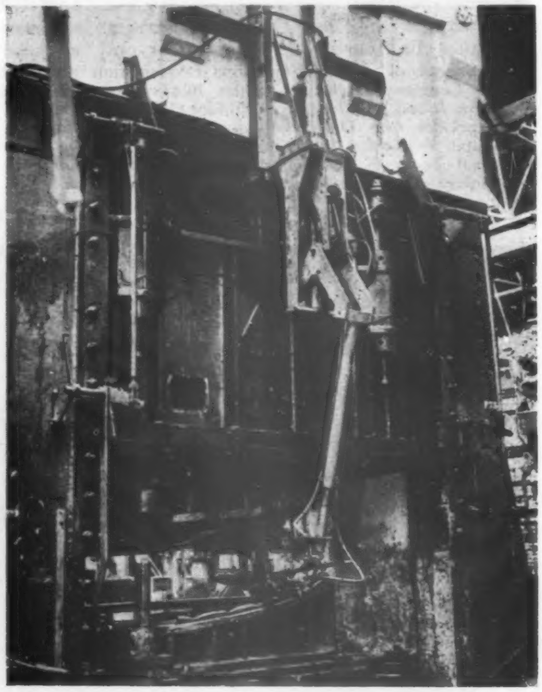


Fig. 12

The 'mechanical hand', an 'Automation' device for unloading components from presses. This does a 'two-man' job.

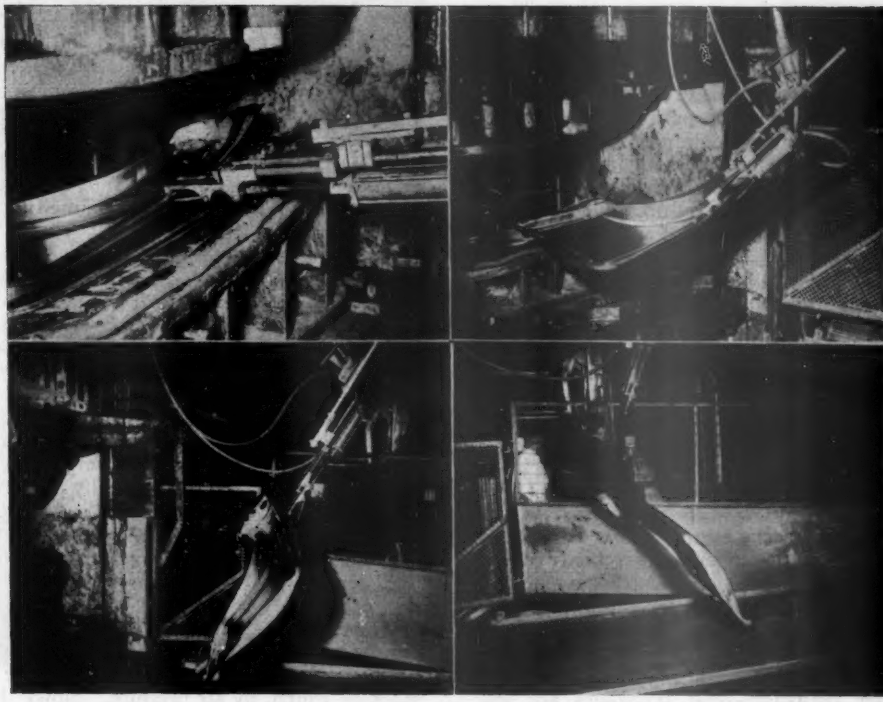


Fig. 13

Four stages of operation by the ' mechanical hand '—the pressing can be dropped on the obverse or reverse as desired.

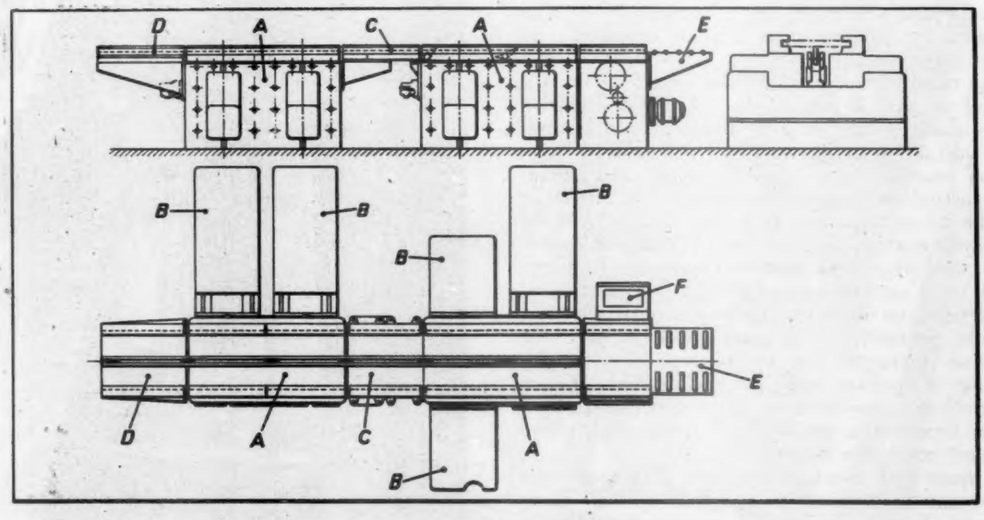


Fig. 14

Base units of the Renault transfer machine. (A) base unit. (B) machine head platform. (C) bridge piece. (D) loading section. (E) unloading section. (F) indexing mechanism.

considerable weight in the case of a cylinder block or head. Therefore, where the shape of the work-piece will permit, the balance would appear to be in favour of the work-piece travelling bare.

In order to provide so much continuity in operation there is a necessity for automatic inspection and this is, in some cases, provided. Renault and Archdale have introduced stations where all holes to be tapped are "felt-out" by a pin gauge set-up, which prevents the machine from being indexed if any obstruction is encountered. Similarly, at the Ford factory at Cleveland, they have inspection and blow-out stations for the same purpose. Obviously there is great scope for ingenuity in this matter of inspection. As in all flow-production procedures, the automatic transfer machine and mechanism throws into high relief those points in which savings can be made, and so spurs management into taking economic measures bv substituting automatic for human means.

Service and Maintenance

There are always queries as to the service of cutting tools and the maintenance of the machines in the wider sense. The cutting tool problem is best handled by a scheduled routine for changes of tools and incidentally of jig bushes. It is quite possible to assess the life of the tools and to make the routine changes within that period. It is true that this will not look after breakages—but breakages are less frequent with keen tools. Tool changes must be made during the "closed" period, that is, at meal-times or after shift-working is finished for the day. If careful records are kept, it is possible to increase the length of time allowed before a change of tools is necessary. Obviously duplicate sets must be kept, with a surplus, to meet emergencies. Emergencies will occur and, when they do, a *post mortem* must be held and, for preference, a written diagnosis and prognosis prepared.

As to maintenance in the wider sense: again it is essential to have a scheme for scheduled attention and to abide by it. A programme should be prepared and a log of all work done should be kept. Regular examinations should be made and adjustments carried out at agreed intervals. "Maintenance must be by anticipation, never by default". Some may object that this is a 'counsel of perfection'—so it is—but the author holds that the Production Engineer should be a perfectionist. Incidentally, since good work depends on the state of the producing machinery, it would probably be a good move to give the inspection manager the job of reporting on the condition of machine tools, jigs and fixtures. Given the right sort of co-operation, between the inspection and the repair departments, such a step might prove to be very profitable indeed.

We must not overlook the fact that automatic transfer can be applied to assembly as well as to machines. In point of fact, the assembly line was the fore-runner of the automatic transfer machine. The most modern assembly lines have adopted a very high degree of mechanisation, as an examination of the Austin assembly line will show. Let us, however, first pay a tribute to the automatic frame-making plant of the A. O. Smith Corporation of Milwaukee. In 1915 Mr. L. R. Smith—the then President—foreseeing that there could be an enormous demand for automatic frames, called upon his engineering staff to produce a plant that could make frames automatically. Eight million dollars and six years of labour went in to this project. The scheme was a success. Flat sheets were fed into the factory at one end to become finished, black painted frames at the other.

The plant is housed in a building some 850 feet in length. It is, in effect, an assembly machine which is almost fully automatic. To make the chassis side members, blanks are pressed from steel strip which has been rolled to the desired width and thickness. A "kick-up" over the rear axle is formed by edge-wise cold bending. This blank is trimmed and pierced for the fittings and then pressed to a channel section by cold forming. These pressings are loaded in to a conveyor which carries them from station to station. At each stop they are automatically presented to tools which perform such operations as punching or drilling holes, attaching hangers and brackets and inserting and closing the rivets. Meanwhile a sub-assembly line, on a lower floor, has by similar methods been producing the cross members and "X" members. The lines meet at the main assembly line where the various components are placed, in position, on moving carriages which proceed to the "nailing" machine which, by air pressure, "blows" home some

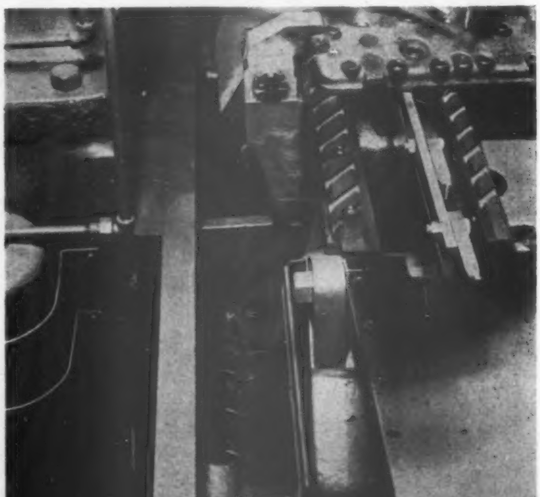


Fig. 15

A detail showing the hardened steel 'ways' or work slides —with the chip 'cut-away'. Also the transfer bar and a screw type chip conveyor.

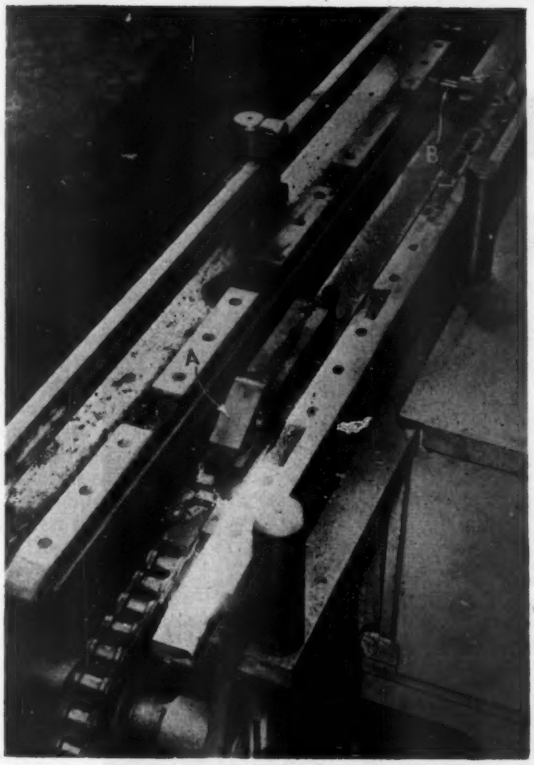


Fig. 16

A chain transfer mechanism introduced by Archdale on the "Bedford" cylinder head auto-transfer plant installed at Vauxhall Motors Ltd.

150 rivets in approximately one second. The frames, thus assembled, are moved on the carriages to the riveting conveyor on either side of which riveting bears move up to the frame—close the rivets (cold) and move back to await the next assembly. (Figs. 17, 18 & 19).

The frame then travels to the welding booths for final operations, thence through a steam bath to paint spraying and on through a drying oven to the delivery dock. The plant is capable of producing frames at the rate of one per eight seconds and it is interesting to note that it is economic to change the set-up for an order of 60,000 frames.

The car assembly plant at the Austin Motor Company is another triumph for automatism. Here in a great hall, one-and-a-half furlongs in length, four conveyors set the pace for the whole of the factory and, incidentally, for all the supplying firms outside. (Fig. 20).

This plant represents one of the major forward steps towards complete automatic control. It has for its objective the reduction of the cycle time by eliminating the waiting periods between operations and of reducing the working capital, locked up in stock in stores and work in progress, to a minimum. At the same time it provides an admirable work-place with nearly ideal conditions for unhurried but steady

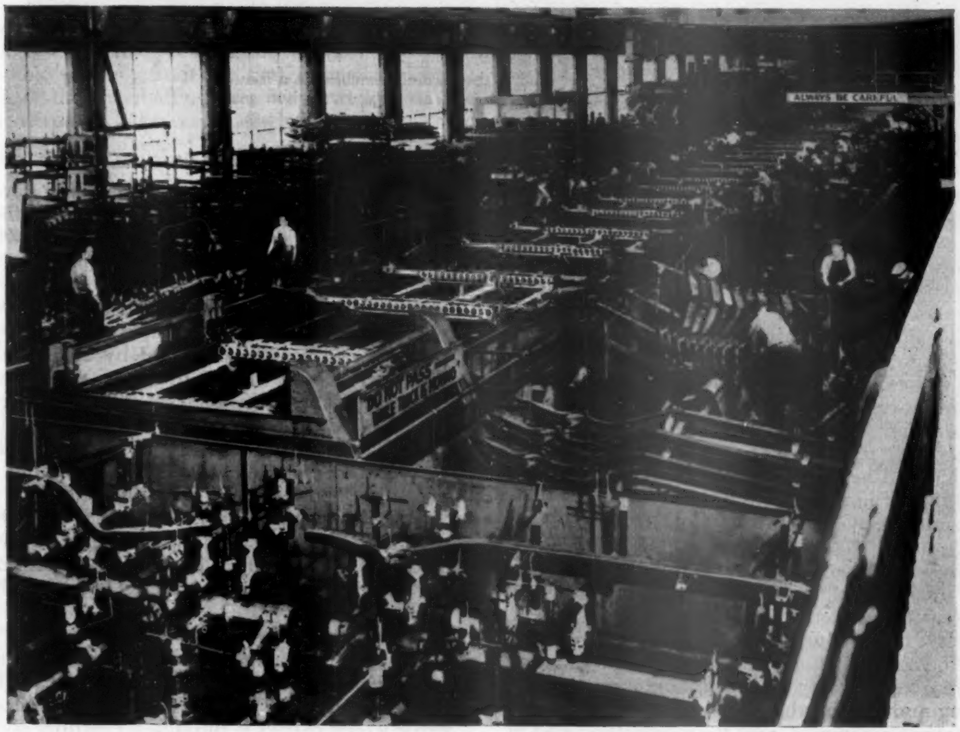


Fig. 17
Automatic assembly lines. The frame-making conveyor line at A. O. Smith Corporation, Milwaukee, U.S.A. The frames are moved from station to station for the addition of brackets and other operations.

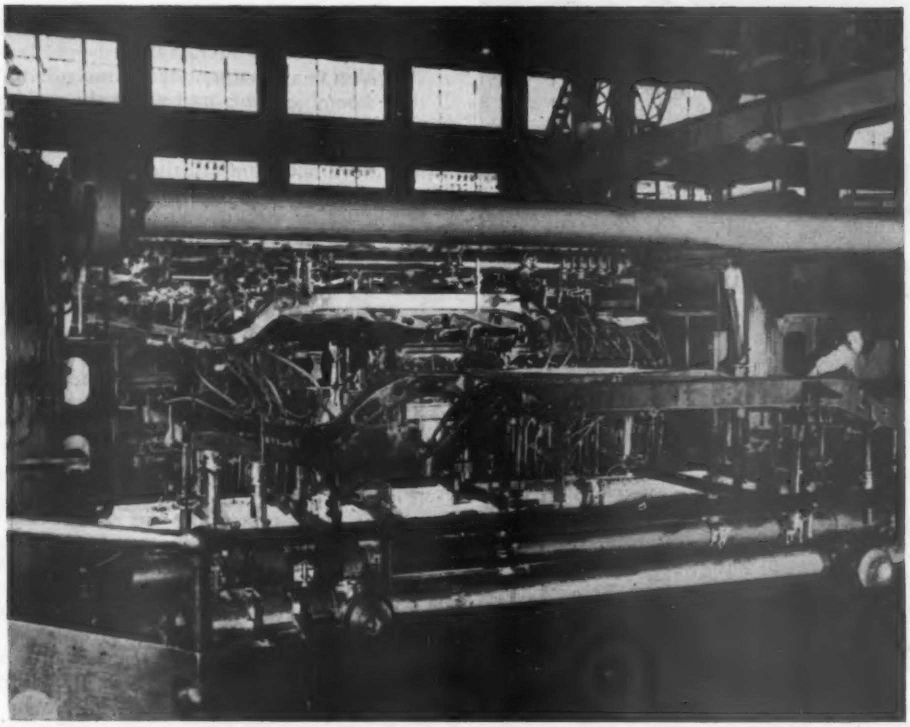


Fig. 18

The frame is carried to the 'nailing' machine in a fixture. The 'nailer' blows—by compressed air—150 rivets into place in about one second.

application to the task in hand. The method adopted, reduced to the simplest terms, consists of marshalling all the components in the order required, delivering them to the right place at the precise moment that they are needed, and providing the proper tools for the workers.

This would be quite a task if only one type of car was in progress, but the plant is capable of dealing with four types of chassis with considerable variations, as, for instance, right and left hand steering and as many as four different bodies, namely:—saloon, passenger van, delivery van and pick-up truck; to say nothing of the variations in colour and trim and the addition of heater and/or radio.

Let us first consider what takes place on one of the assembly tracks—say the "Somerset" or A.40 line—and then work back to see how it all happens.

This track is laid out for the production of 2,000 vehicles in an 80-hour week. Although, in effect, the track is continuous it is actually in four sections, the first being devoted to chassis assembly, the second to chassis painting, the third to oiling and body mounting and the fourth to final connections.

The assembly commences in the marshalling area of the individual component stores where the slat conveyor, on which are mounted various fixtures, is loaded with such items as propellor shafts, rear springs, silencers, exhaust pipes and so on—down to nuts and bolts.

As the conveyor emerges from this area, the frames are placed on their fixtures by a Telpher drawing from a frame stock which is held in sequence to match the pre-planned output. At the next station the rear springs and shackles are attached to the frame which, proceeding to the next station, receives the rear axle and front suspension delivered by an elevator from a tunnel 20 feet below the floor of the assembly building. These components are attached to the chassis—the propellor shaft, brake mechanism and cable harness being added at succeeding locations.

At another station, the engine assembly elevator drops the power unit into the required position "within less than half a hole" so that the fitters can, with a minimum of manipulation, bolt it into place. Then the clutch control is added and that portion of the steering mechanism carried by the chassis is coupled up.

At this point the slat conveyor returns to its starting point, the lids on the boxes that hold the nuts and bolts automatically closing. The chassis is lifted automatically and suspended on an overhead conveyor which carries it through a chamber containing an electro-static paint spraying apparatus which covers all the iron and steel parts, except those that are masked, with rust-resisting paint.

The chassis continues through a hot air drying booth to be lowered to another slat conveyor for further operations. It first proceeds to an oil filling station where the appropriate oils are delivered in measured quantities to engine, gearbox, rear axle, steering-box and the braking system, which is filled and bled at this point. This is an interesting operation since the chassis is travelling all the time and the service pipes are trailed along by a linkage, which engages the track and returns in time to pick up the next chassis.

The exhaust system, which by-passed the spray painting operation, is now fitted, by which time the chassis has arrived at the elevator which deposits the body on the chassis. The road wheels which travelled in the boot are fitted to the hubs—a multi-head nut runner tightens all the nuts at once. Water is now supplied to the radiator and sufficient petrol for test and movement is put in the tank.

The car now enters on to the fourth conveyor—an elevated double strand slat track—which enables work to be carried on all around and underneath the car. The body is securely fastened to the chassis and the steering-box which is mounted in the body is coupled to the drag link on the chassis. At the following stations the bumpers are attached, the seats are positioned, the electric wiring is completed, such cleaning as may be necessary to remove the witness of handling is done, the tyres are inflated to the correct pressure and the finished car is driven off the track for final inspection and test. It then proceeds to the despatch department accompanied by the necessary vehicle release documents.

The whole process, from the first item placed on the track in the marshalling area to the delivery of the car to despatch, takes less than 4.5 hours.

Importance of Planning

As in all automatic transfer mechanisms, the key to the situation is found in the incidence of the operations which are controlled by the time and sequence elements. Hence the process starts with a pre-planned production schedule—the prefix is used deliberately for there is no room for slipshod planning in this connection. A master list is compiled which shows the types of models required (they run into some 800 variations) and the sequence in which they are to be delivered to the despatch department.

From this list packs of punched cards are produced on "Hollerith" equipment; these indicate the types of units that will be needed. The cards are intended for the Austin "home" factories that produce the main assemblies (power-units, rear axles, front suspensions and bodies) and also for the storage area which forms a reservoir to balance the assemblies which are produced at varying rates in the "home" factories.

Hollerith machines in these departments, actuated by relays on the track, pass each card, in turn, through an electric field which makes a contact, in accordance with the punching of the card, to set in motion the assembly indicated in the pre-selected order. Should the card be blank the units will remain stationary; this means that the output can be varied although the speed of the tracks is constant.

The assemblies are moved by dogs on the chain conveyors, which will ride over the units until solenoid operation lowers the chain to effect engagement.

The assemblies when loaded in the correct sequence travel first to the storage area and then, as needed, through a 1,000 foot long tunnel to halls under the assembly lines. Here the units are transferred to the particular sidings which serve the assembly line to which they are allotted. Thus the "Somerset" assemblies are switched to the A.40 elevator bay, the "Hereford" assemblies to the A.70 bay and so forth. The assemblies wait like taxicabs on a rank until they are "whistled up" by the customer. The "whistling-up" is accomplished by electrical connections made on the tracks. The elevators hold the unit suspended for a brief period to enable the correct position between assembly and chassis to be established, when the elevator will lower the unit and the slings will automatically disengage.

In the meantime, the individual components (the majority of which come from outside suppliers) are delivered to the bulk stores at the head of the assembly lines. Here sufficient stock is held to take care of any likely interruptions to deliveries. From the bulk stores, the components are moved by fork-lift trucks to the marshalling area through which the assembly conveyor runs. As mentioned these parts

Fig. 19

The frame passes, on a conveyor, through a line of riveting 'bears' which advance, close rivets and retire. This line is automatic.

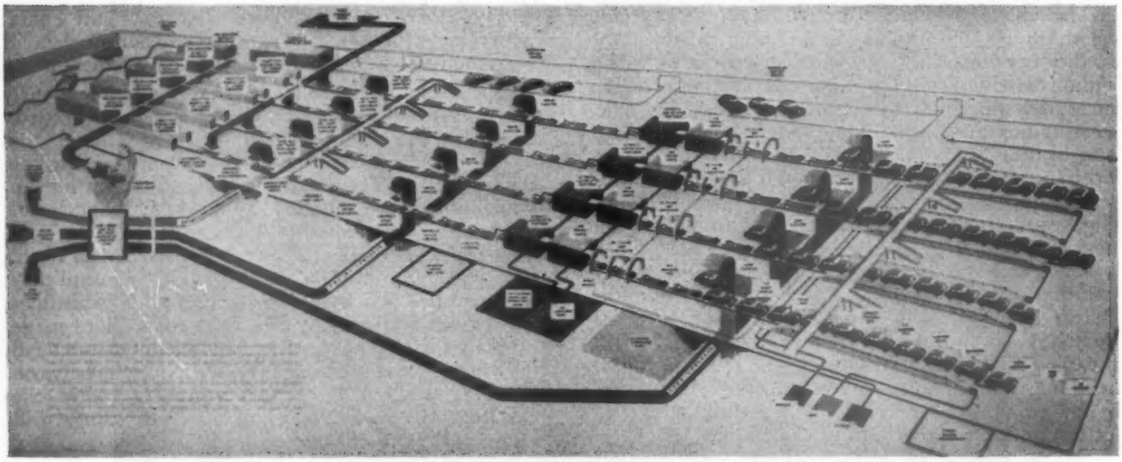


Fig. 20

The assembly line at the Austin Motor Company Ltd. is semi-automatic in character, and is one of the major contributions to the art of assembly.

are placed in sets on the conveyor so that they come conveniently to the hands of the assemblers, who do not have to turn round or change stance to pick up the required pieces. This alone is an improvement on old type assembly lines where components would be arriving from all directions.

It might appear from the foregoing that this method of assembly is somewhat inflexible. This is not so—normal variations can be introduced within 90 to 120 minutes according to what is needed, and even colour changes which involve operations remote from the assembly line can be made in a matter of eight hours.

This is, of course, only a thumb-nail sketch of one of the most original and interesting developments in flow production. It was achieved by the close co-operation of the planning and engineering staffs of the Austin Motor Company with their contractors, Geo. W. King Ltd., who provided all the conveyors, the Donovan Electrical Company who supplied the control gear, C. C. Wakefield and Co. Ltd., who were responsible for the oil dispensing unit, the British Tabulating Machine Co. Ltd., for the punched card operating machines, the Carrier Engineering Co. Ltd. who, collaborating with Henry W. Peabody (Industrial) Ltd., were responsible for the paint spraying equipment. (E)

Part II

Having reviewed the present situation in regard to these new developments we can turn our attention to the future. The following are the questions which are likely to be asked:—

(1) Are these machines and mechanisms likely to persist or are they liable, after a period of experimentation, to be replaced by individual machines?

(2) Is there any possibility that they will be applied in other industries than the one that sponsored them—the automobile industry?

(3) Are these machines likely to develop so that they can make complete components?

(4) Are we likely to see completely automatic factories?

(5) What will be the social effect of the adoption of such machines and methods?

It will be noted that each of these questions involves directly or indirectly the question of economics for, no matter how ingenious may be these methods and mechanisms, they must—with certain possible exceptions—withstand the test of economic congruity. The exceptions being where the work to be done is abnormally unpleasant or excessively laborious, or where there is a great shortage of manpower. In such conditions any mechanism that will solve the problem may be acceptable even when not justifiable on strictly economic grounds.

The claims made for the existing machines in places where they are justified, because of the required output, are that production has been increased by as much as five to six times that possible by normal machines and methods and that overall savings of 50% to 75% can be realised.

As to the cost of the machines, it has been claimed that they are cheaper than a group of normal type machines *that are capable of producing the same output.* They take up less floor area and they require fewer operators. They need, of course, proper attention and skilled maintenance but no more than that which should be given to normal types of machines performing similar functions, and probably less when measured against their output. The automatic portions mean just so much more to look after—in volume but not in difficulty. Naturally, breakdowns are serious, because the whole line depends on each individual machine head or each piece of operating mechanism, but is this not also true of an ordinary 'flow-line' set-up and, if we face the facts, is it not

really true—although hidden—in any other form of production? It can therefore be accepted that the argument for or against automatic transfer operation lies in the question as to whether the volume of work to be done, and the rate at which it has to be done, is sufficient to justify the use of such machines and also whether the firm concerned can afford to await the delivery, setting-up and trying out time that will be necessary. This last point depends largely on the manner in which the automatic transfer machine develops; to which we will return later.

With these preliminary observations we may now turn back to the queries.

In the author's opinion the answer to the first is definitely in the affirmative. These machines and methods have come to stay. Given the right conditions the automatic transfer machine offers the same overwhelming advantages that the turning automatic has over the centre lathe; in both cases the actual cutting time is the nearest possible to 100% efficiency. As to a return from the automatic transfer to the individual machine, it could only happen if the situation which led to the adoption of the automatic transfer machine—in the first place—had been badly misjudged.

Regarding the second question, there is every probability that all the end producers who have adopted the flow production process will graduate to automatic transfer machines and mechanisms. It is the logical outcome of flow production methods.

The third question refers, of course, to complete components made outright, ready for the assembly line, on one machine. There is in the author's opinion no technical reason to prevent the development of the integral machine in any form or size. Even in 1924-25 this was shown to be possible and there were indications that it might be desirable. Moreover, some of the smaller components are now being made throughout on single automatic transfer machines. Nevertheless, it is desirable to proceed with caution in this matter.

Linking by Automation

The Ford Motor Company has, in its American factories, shown how this can be done—not by very large and complex integral machines but by linking lesser automatic transfer machines by "automation" —thus providing another answer to this query. The Ford method has the advantage that the burden of supplying machinery can be spread over the whole of the machine tool industry, so that those makers who are best qualified by experience to produce certain types of tools will still be able to render their valuable and often unique services.

Fourthly, are we likely to see complete automatic factories? Well, it is obvious that all the elements for the automatic factory (so called) are available. As to how far this will be carried is largely but not entirely a matter of economics. Human relations problems are involved. The placing of the employees made redundant by an automatic machine provides little difficulty. The re-deployment of the whole personnel on a change over to a completely automatic factory is something quite different; moreover, the assembling of the mechanic force for the building, maintenance and service of such a factory is a very formidable problem. The author believes the automatic factory is a definite possibility and that in due course it will arrive but not, in all probability, very quickly.

The Most Important Question

The fifth and, in the author's opinion, the most important query is:—What will be the social effect of the adoption of automatic transfer machines and mechanisms? It appears to be generally agreed that in the short term the use of machinery is liable to cause unemployment, but that in the long term it increases rather than diminishes employment. With this the author would not disagree but would point out, in passing, that this latter is due to a rising scale of living (more goods) coupled with a diminution in the hours of labour (more leisure). Both these conditions are a concomitant of the machine age.

Nevertheless, the short term is all-important to those involved in "technological displacement" and, emphatically, they must not be sacrificed. Any company adopting labour saving machinery should be prepared to find employment or, at least, to assist in finding employment for those displaced. This may appear altruistic—to a certain extent it is—but it is also good business, since it is impossible to secure loyalty for a firm which is inconsiderate to its employees. Loyalty, it may be added, is a very good lubricant for the working of automatic machinery. It must not, however, be forgotten that an automatic transfer machine which produces, say, five times the amount made by the machine line it supersedes does not, in fact, reduce the personnel by 80%. As indicated, scheduled attention to cutting tools and time-table maintenance is essential for this type of plant, hence the nett displacement is likely to be in the region of 50%. Some of those displaced would no doubt be available for maintenance and service duties. Thus the problem can be reduced to manageable proportions and provided the situation is recognised and an active remedy is sought, it should not be insoluble. It is now becoming recognised that in modern industry we are continually altering the status of our works forces by transferring more and more men through that invisible door which changes them from machine operatives to supervisors, technicians and other categories.

To the public at large, these new methods will mean lower costs and therefore lower prices and a wider range of goods within their purchasing range. There should be no diminution in the quality of the goods; in fact, unless spoiled by a deliberately dishonest use of these new tools or unwittingly damaged by over-quick assembly, the goods should be better for the accuracy demanded by these new methods.

Simplification and standardisation enter into the picture and it may be said that this will reduce variety and so tend to make existence "flat, stale and unprofitable". Well that again depends on the use made of the machines. There are so many articles made where there is no need or sense in variety—where no one is a penny the worse because of standardisation—that no thinking person and certainly no one

responsible for sales would wish to carry standardisation to a point where it is hurtful. The author ventures to say that increased competition in end products will ensure that there is variety in plenty in those personal aspects where variety really matters. The prophets of woe, who are for ever attacking the "assembly belt", will probably find another "Aunt Sally" in the automatic transfer machine but, since we know that by the use of such machines the mortifying physical effort is being taken out of labour and since we are aware that, during the life-time of many of us, the standard weekly hours of work have been reduced by 20%—and that the process will continue—who cares?

Part III

Such bold projects as have been described cannot, possibly, be dismissed as pipe-dreams. They are too realistic. There are very real reasons behind these endeavours to introduce automatisation into machinery and assembly operations. The urge in regard to assembly lies in the fact that the assembly line constitutes a vast metronome for the whole of the factory (and for the suppliers to the factory) and, due to the measured output, the inventory may be reduced to the minimum, thus economising enormously on stores, space and equipment.

The urge in regard to the machines lies in the fact that by these means the utilisation of machines is so much greater than with the older manual methods of loading and unloading. We have for more than three generations paid the closest of attention to increasing the efficiency of cutting tools, and now we are turning our attention to the loading and unloading cycle in which there are greater possible economies than in any other operations. Man-handling cannot hope to match the cutting capacity of the modern machine; therefore we shall be forced to consider mechanical handling through all manufacturing stages.

The Time Element

One of the difficulties in the building of transfer machines is the time element because they, of their nature, are all "specials". Consideration will indicate how this difficulty can be met. In the first place we must not be too ambitious. The machine for manufacturing complete components may not be within reach but as Ford has done in America, less ambitiously designed machines can be joined to give the same automatic effect. In addition, it would seem obvious that simplification and standardisation must be applied to the machines in a proportionate measure to that amount of thought that has been given to the products of the machines. This applies generally to the construction of the carcase or bases, to the operating heads, to the transfer mechanism, the clamping devices and the control contrivances.

The carcase could, obviously, be built of standardised sections but no one has, so far, standardised such sections. Usines Renault would appear to have made a considerable contribution in this direction; for in their system there is a "Meccano"-like flexibility which permits of a build-up of any number of units. Moreover, it takes into consideration the problem of alignment which is liable to arise when the group-machine becomes over-long.

It would seem essential for machine heads to be designed as self-contained integral mechanisms simplified to the last degree. In multi-drilling two heads or three may be better than one if this leads towards simplicity in operation—a simplicity which might well involve two, or even more, operating stations instead of one. In the transfer machine it does not much matter if twenty-four holes are drilled by one 24-spindle machine or two 12-spindle machines. The transfer mechanism looks after the movement and the location is simple, effective and accurate. Transfer and clamping mechanisms can, so far as the actuating parts are conceived, be standardised. The transfer bars and shafts lend themselves to such variations as may be required. Both pneumatic and hydraulic mechanisms are used with mechanical or electrical controls.

The idea of making self-contained "package units" is much to be commended. If anything goes amiss the service leads can be uncoupled, a new unit can be installed in a few minutes and the faulty unit can be taken, *en bloc*, to the service or maintenance station where it can be handled expertly under proper conditions.

Two examples of "package" units are of considerable interest. The first is a compressed air operating cylinder which comes complete with built-in direction valves, speed regulating valves, solenoid operating controls and, if required, a "hydro-check" to give the smoothness of hydraulic operation combined with the

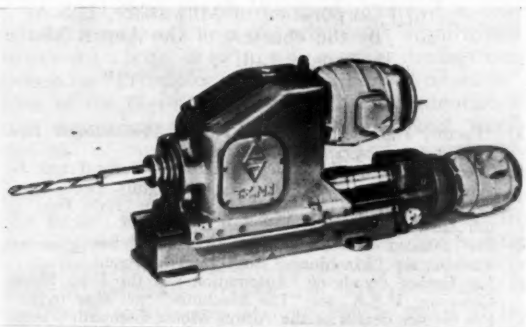
Fig. 21

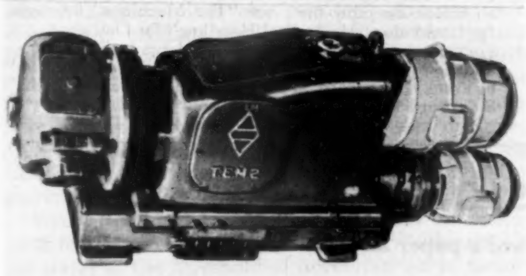
Compressed air 'package' units such as are used for operating transfer mechanisms. The two upper photographs show 'push and pull' units, the lower is for a rotary movement.

speed and flexibility of compressed air, can also be incorporated—all in the one unit. The only connections are those for bolting the cylinder to the machine, two electric leads and one flexible air hose.

The other example is that of an hydraulic unit in which a cabinet contains the motor, hydraulic pump, filters, piping, the necessary valving and the tank, for the hydraulic fluid, upon which the motor and pump are mounted. The connections in this example consist only of the electric leads to the motor and the flow and return pipes. Internally all joints are gasket sealed and no pipes have to be unscrewed to remove any of the units. The first cost of these "package" units may be high, but they are, in the long term, much more economical. These two examples come from the U.S.A. (Figs. 21 & 22).

The "package" idea should apply to all the units





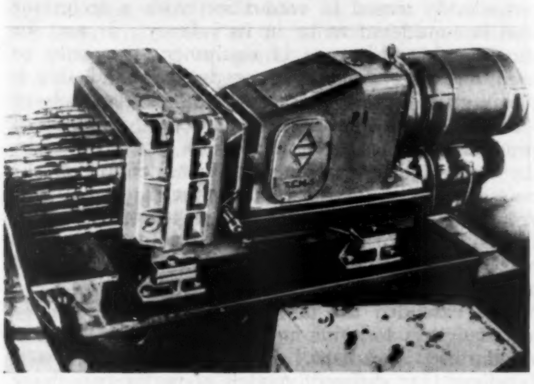


Fig. 23

Single-spindle and multi-spindle drill heads made as package units. The middle photograph shows an attachment for milling. These heads are quite self-contained.

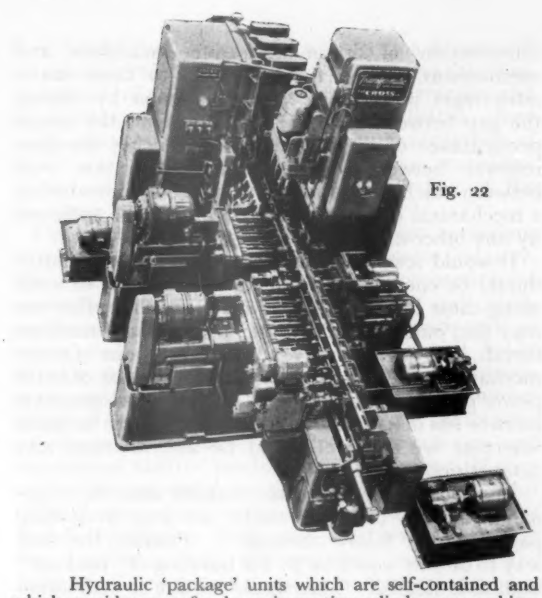


Fig. 22

Hydraulic 'package' units which are self-contained and which provide power for the reciprocating cylinders on machines and transfer units. Note three alongside this Cross 'Transfermatic.'

in the automatic-transfer machines or in the independent transfer mechanisms ("automation") linking the machines. All the units should be integral and so designed that they are immediately replaceable; moreover, the electrical units should be made so that diagnosis of any trouble can be made without delay, that is to say the assemblies should be integral and the connections of the simple "plug-in" types. It would be preferable for all services to be carried in or on the machine carcase or bases, including electric, pneumatic and hydraulic power, the lubricant and, if required, the coolant conduits and, where possible, the swarf conveyor.

To make sure that the point has not been overlooked, perhaps it may again be stated that the operating heads should be self-contained independent units. (Fig. 23).

If all the units which go to the making of automatic transfer machines and mechanisms could be built on the unit principle, it would greatly facilitate the progress of this latest method of production to the great advantage of the end producers and the purchasing public. It is not suggested for a moment that end producers only might benefit from this method—it can obviously be applied to the component part manufacturers and even to the earlier stages of production—the raw and semi-raw materials.

Are there any lessons that we can learn from a study of the possibilities of the automatic-transfer machine? The author would not, on such a subject, wish to be—or appear to be—dogmatic but, having come so far along the road, he feels that he should make an endeavour to sum up the situation as he sees it; in a word, he feels that in addition to adorning a tale he should also point a moral.

There would appear to be no doubt but that a great forward step in method has been taken by the

introduction of automatic transfer machines and mechanisms, a step that will add to those many advantages inherent in flow production by closing the gap between machine capability and the actual performance of the machine, by reducing the time interval between operation and operation and between machine and machine. Also by introducing a mechanical discipline which could not be achieved by any other means.

It would seem then that engineers in this country should be encouraged to make a bold effort to work along these lines. If we do not make that effort we may find ourselves still further behind our American friends, who have always made the utmost use of every mechanical aid (the secret of their greater use of horse power per man employed). This new development is more or less in its infancy and if we apply these methods wherever we can we should be able to meet any competition.

The idea of the automatic transfer machine originated in this country; ought we not, in golfing parlance, to "follow through"? Possibly the best way to do this would be by the building of "package" units as indicated. That would require co-ordination and co-operation. How can we create the conditions where specialised machinery can be built from standardised units? Is this a task for the machine tool builders? . . . for the manufacturers of the electric, hydraulic and pneumatic components? . . . or is it a job for the makers of end products themselves? Is it a task for one firm or for a group of firms? These are questions which should be asked and much depends on the answer.

ACKNOWLEDGMENTS

The Author and the Institution make grateful acknowledgement to the following for permission to reproduce the illustrations indicated:—

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(A) "Factory Planning" by H. E. Taylor—Proceedings: Inst. Prod. Engrs. 1922/23.

(B) "Some Notes on Continuous Production" by Frank G. Woollard—Proceedings: Inst. Auto. Enginrs. Feb. 1925. See also articles in "Machinery" from 12th Feb. to 9th April 1925 (inclusive).

(C) For detailed account of the Morris/Archdale gear-box machine see "Machinery" 10th January 1952.

(D) For further details of "Automation" at the Ford Motor Company, U.S.A., see "The Machinist" 3rd May 1952.

(E) For further details of the Austin Motor Company's semi-automatic assembly line; see "The Machinist" 8th Sept. 1951, and also "Mechanical Handling" for Oct. 1951.

** For information on auto-transfer machines in flow production see "The Basic Principles of Mass and Flow Production" by Frank G. Woollard, appearing in "Mechanical Handling" from April 1952 onwards.

DISCUSSION

The following comments on Mr. Woollard's paper have been received:

From: Mr. HAROLD BURKE, Chairman of Council.

'Productivity' is the word that is most used in this post-war period, to describe the manufacturers' reaction to the problem of our national economy. Numerous delegations have visited other countries to study this problem; much discussion has taken place; and endless Reports have been issued on the subject. All this work is completely pointless, unless some appropriate action is taken. Mr. Woollard's paper, first of all, allows us to coin the word 'Transfermatic' to describe this form of production technique; and secondly, makes a powerful and decisive contribution to the solution of the practical and technical difficulties that are encountered in studying production developments.

The subject demands very careful study. A hurried glance at the paper may give an impression of H. G. Wells' "Things to Come", and in this connection, it is well to remember that Mr. Woollard is writing with a background of thirty years' experience in the development of 'Transfermatics'—truly, a remarkable record in connection with a technique that is considered to be in its infancy. It may be thought that this type of equipment can only be used for large scale mass production, and this is partly true. Bearing in mind, however, the large section of industry that is concerned with mass production on a smaller scale than that enjoyed by the motor industry, we need to consider further the manufacture of standard units that can readily be grouped and re-grouped to meet the ever-changing demands of world trade. This is a matter for the machine tool trade and, in my view, requires urgent attention.

The extended use of 'Transfermatics' may force our designers to think more positively in terms of standardised products. For example, there are, I believe, 125 different models of motor cars being made in this country, and however much we may wish to encourage individual initiative, there is no case made out for the multiplicity of sub-units of different design and size that go to make up the

motor car. We do not need to be complacent, nor envy the American industry with its large quantity production—there is something we can do now in this country, if we exploit to the full the techniques outlined in this paper.

The result must surely be a steady scaling down of selling prices, and a restoration of our position in the world's markets.

Mr. Woollard is to be congratulated on the most excellent way in which he has dealt with the background of 'Transfermatics', but more particularly on his vision for the future—forthright, practical and to the point. It is truly a worthy contribution to the first issue of the new Journal.

From: Mr. DAVID H. BRAMLEY, Head of Department of Industrial Administration, College of Technology, Birmingham.

In 1950, Mr. Frank Woollard accepted a commission from the College of Technology, Birmingham, to present a series of lectures to a senior management course on "Principles of Mass and Flow Production". One of the objectives was to focus the attention of top management on the possibilities and implications of automatic transfer and automation as the logical development of manually-operated flow production systems. Production Engineers in the British Isles owe a great debt to Mr. Woollard for his work in examining and analysing the position as he finds it in 1952, for it was he who pioneered the idea of automatic transfer in the production of machined components as long ago as 1924, at the Morris Engines plant at Coventry. At that time, despite the brilliant production team he had about him, Mr. Woollard found some of the difficulties insurmountable, but it is now obvious that we can forge ahead for, like many another idea originated here, the principle has been taken up and exploited to a considerable extent in the U.S.A. and on the Continent. We also have evidence of the use of automatic transfer machines in the U.S.S.R.

Without allowing our imagination to run away with us it is obvious, from Mr. Woollard's thesis, that we stand at the threshold of developments in factory organisation which will have as much effect upon our industrial society as the advent of jet propulsion in aviation, and of atomic energy as a source of power. Some may say that costly elaboration of production machinery to achieve automatism must restrict the development of product design. To this objection there seems to be two answers: first, to observe that some of the most successful product designs of consumer goods—including motor cars—have remained almost static for the past twenty years: second, to follow Mr. Woollard's signpost towards simplifying the operations to be performed at each stage of an automatic transfer plant, and thus to achieve standardisation of the machinery units and control mechanisms on a "package" basis, so that they can be rearranged with facility to accommodate product design modifications. Others may say that automatism can have only a limited application. This is undoubtedly true, but Mr. Woollard has said sufficient to indicate that in any situation where the repetition factor is great enough to justify flow production, automatic transfer machines and automation must be considered. Viewed in this way, acceptance of the principles of automatic transfer and automation makes obsolete many British flow production plants devoted to the manufacture of motor cars, vacuum cleaners, washing machines, clocks and radios—to mention only a few of the consumer products involved.

One thing puzzles me about current incursions into automatic transfer plants by the motor industry. Why pick on some of the most complicated components—cylinder blocks, cylinder heads, and crankshafts, when there are simpler components such as valves, valve rockers, pistons, steering and brake linkages to work on; some with higher repetition rates and less risk of modification? But another thing is clear: development of the automatic transfer and automation principles demands new and exceptional skill in production engineering. If they are to be successful in the British Isles, we must redouble our efforts in the education and training of British Production Engineers—the responsibility of this Institution and the technical college. The Institution's educational policy is developing but as yet it hardly fulfils the needs of to-day. It must be rewritten for the men we train to-day for the age of automatic transfer and automation.

From: Professor T. U. MATTHEW, Ph.D., M.I.Prod.E. Head of Department of Engineering Production, University of Birmingham.

The automatic transfer principle has been applied successfully between automatic cycle operations in an astonishingly wide range of process and product industries during the past 50 years, but it is only recently that it has been possible to apply it successfully to the machining sequences used in the production of precision components required by the automobile industry.

Mr. Woollard's paper draws attention to the significance of this development in the course of a masterly review of the past, present and future prospects of automatic transfer mechanisms applied to machining sequences.

The engineering details referred to in the paper are interesting examples of the practical methods used in overcoming the difficulties inherent in "automation". It is, perhaps, equally important to define the basic planning requirements which must be met if this type of equipment is to be applied, not only in the mass production industries where the capital cost of such equipment can be more readily justified, but also in industries concerned with the precision machining of comparatively small batches of components.

In the design of automatic plant for continuous flow production on a batch basis, where a series of components are to be fed forward to a final assembly line, there are three basic planning principles of major importance which must be taken into account to make this type of plant economically advantageous.

These are, first: the different component lines must be timed and phased so that all parts come together at the correct rate and in proper sequence

for sub and final assembly. Without this provision, finished component stocks are likely to become uneconomically large. Second, the number of components in transit between major operations must be sufficiently large to allow for normal delays on individual units in the automatic group. Without this provision, the need for stoppages of the entire line must be anticipated.

Third, flexibility of design and operation must be provided. Flexibility must be built into the basic machine design in such a way that major changes in machining operations from one component batch to another may be accommodated without major changes to machine heads or mountings.

This type of flexibility is essential to guarantee that it will always be possible to adapt the machine and thus to spread the initial capital outlay sufficiently widely to permit low capital charges.

Flexibility must also be provided in machine operation in a number of ways, such as (*a*) by allowing for rapid by-passing of machines which develop faults, or alternatively, by providing stand-by units and replacement tools which can be quickly substituted should failure occur; (*b*) by dividing machining operation lines into automatic transfer groups with inter-group buffer stocks such that stoppages in any one group need not affect the general flow of production; (*c*) by providing means for altering the relative speed of adjacent automatic groups so that the production balance may be restored from time to time.

In addition to these planning principles, there are a number of engineering principles which must also be observed in the detailed design of such equipment. The most important of these are:—

(i) the provision of safeguards against serious damage caused by tool breakage, misalignment of parts, or the introduction of defective parts from previous operations. Overload trips, electrolimit switches and automatic or visual inspection at danger points are commonly used safeguards.

(ii) the provision of positive means for maintaining accuracy of alignment and for holding key dimensions within the required tolerances.

Reference is made in the paper to a number of methods, such as locating and clamping against non-wearing surfaces, and the use of hardened steel dowels and bushes. Attention must also be directed to the use of kinematic design principles in this connection.

It is interesting to note that many of the examples quoted in the paper, and many other existing plants based upon the automatic cycle and automatic transfer principle, embody at least a number of these planning and engineering principles.

In one example mentioned, the A. O. Smith car frame plant, all these principles have been observed and in particular the engineering requirement of flexibility has been met to a degree which has enabled the plant to maintain continuous operation over 25 years, and to be adapted continuously to meet wide changes in the style, size and shape of the product.

The future use of such machines in British industry will depend to a major extent upon providing the same degree of flexibility in this type of plant.

From: Mr. T. W. ELKINGTON, M.I.Prod.E., Director and General Manager, Peter Brasshouse, Ltd., Birmingham.

I heartily endorse Mr. Woollard's opening remarks that never has such a major development of production engineering received such little national publicity or comment.

On the other hand, Mechanical Handling has had a great deal of attention, and is now accepted as the term used to cover inter-departmental handling.

Too little attention has been focused on the broader conception of Materials Handling—which is now acknowledged as the term used to cover the movement of material right through the production plant, in other words, from "door to door".

Materials Handling embraces handling at the "work point proper", which has been designated "inter-process handling" and which, in the main, involves precision engineering and a great deal of production engineering ingenuity.

The automatic transfer machine is the logical development of the co-ordination of handling and the machine—the natural blending of two facets of production engineering.

Mr. Woollard has given us a sound picture of the strides made in the motor manufacturing industries in the use of this technique, and has given proven examples of the economic values of these projects. British manufacturing industries as a whole would be wise to weigh carefully the possibilities of similar systems where quantity production is required for, without doubt, other products can be effectively handled with automatic transfer machines. The basic principle is—"dispense with handling wherever possible, for it adds nothing to the job except its cost !"

Production Engineers must at all times be alive to wastage due to excess handling and although there are many jobs where, for technical reasons, difficulties arise to prevent manufacture on the same scale as in the motor industry, economies can be made by using the same approach. While the economies of "Inter-Departmental Handling" are difficult to assess—for they cover the whole plant and are eventually absorbed in the overheads—"Inter-Process Handling" or handling at the "work point proper" can be accurately ascertained. Many of the advantages such as the reduction of fatigue; reduction of scrap, and damage; and the saving of floor space, can be valued only as keeping in step with the times—the natural progress of industry.

The points upon which to assess the economic value of a transfer machine's installation must be more definite and have strict bearing on the selling price and quality of the product. Production Engineers therefore must base their calculations on:—

(*a*) The quantity to be produced.
(*b*) The increased output expected.
(*c*) The labour cost.
(*d*) The amortisation of the equipment over the contract period.
(*e*) The cost of maintenance and replacement.

The further extension of this technique throughout industry in general depends on concrete propositions being put before the Boards of Directors and Produc-

(*continued on page 46*)

NOTICE OF ANNUAL GENERAL MEETING

Notice is hereby given that the Annual General Meeting of the Institution will be held at 36, Portman Square, London, W.1, on Thursday, 29th January, 1953, at 4 p.m.

AGENDA

1. Notice convening Meeting.
2. Minutes of previous Annual General Meeting (below).
3. Report on Election of Members to Council (1).
4. Annual Report of Council (2).
5. Presentation of Statement of Income and Expenditure, Balance Sheet and Auditors' Report (3).
6. Election of Auditors, 1952-53.
7. Election of Solicitors, 1952-53.
8. Votes of Thanks.

By Order of the Council,
W. F. S. WOODFORD, *Secretary.*

1. See page 38
2. See pages 38 to 46
3. See pages 44 to 46

MINUTES OF THE ANNUAL GENERAL MEETING HELD ON WEDNESDAY, 23RD JANUARY, 1952

The Thirtieth Annual General Meeting of the Institution was held on Wednesday, 23rd January, 1952, at 7 p.m., at the Headquarters of the Institution, 36, Portman Square, London, W.1. The Chairman of Council, Mr. Walter C. Puckey, presided.

The Chairman apologised for the absence of the President, Major-General K. C. Appleyard, C.B.E., who was in the U.S.A.

Notice Convening Meeting

The Secretary (Mr. W. F. S. Woodford) read the Notice convening the Meeting.

Minutes of previous Annual General Meeting

The Minutes of the previous Annual General Meeting, which were taken as read, were confirmed on the motion of Mr. H. P. Jost, seconded by Mr. M. Seaman.

Election of Members to Council

The Report on the Election of Members to Council was received on the motion of Mr. F. T. Nurrish, seconded by Dr. H. Schofield.

Annual Report of Council

The Chairman, in proposing the adoption of the Annual Report of Council, said that with the permission of the meeting he would take the Report as read. He called attention to and read some of the more important items which it contained. After a short discussion, the Report was adopted.

Presentation of Statement of Income and Expenditure, Balance Sheet and Auditors' Report

Dr. H. Schofield, who moved the adoption of the accounts, said that the increase in the subscription income was a welcome one, but they must not rest on their laurels ; there were more members to be obtained to assist the Institution in its important work.

Mr. H. Tomlinson seconded the motion, which was carried unanimously.

Election of Auditors, 1951/52

On the motion of Mr. J. D. Scaife, seconded by Mr. H. P. Jost, Messrs. Gibson, Appleby & Co., Chartered Accountants, were re-elected Auditors to the Institution and were thanked for their services.

Election of Solicitors, 1951/52

Mr. T. Fraser moved that Messrs. Syrett & Sons be re-elected Solicitors to the Institution and that they be thanked for their services. The motion was seconded by Mr. M. Seaman and carried.

Votes of Thanks

Mr. F. C. White proposed a vote of thanks to the President, Major-General K. C. Appleyard ; to the Chairman of Council, Mr. Walter Puckey ; and to the Vice-Chairman of Council, Mr. Harold Burke, for the splendid and invaluable work which they had done for the Institution during the last two years.

The vote of thanks was carried with acclamation.

The Chairman, Mr. Puckey, acknowledged the vote of thanks on behalf of his fellow officers. He said he knew of no better secondary line of activity (if he might so express it) to pursue than work for the Institution, and since he had undertaken his present task at the Ministry of Supply he had seen even more clearly than before the great need for a strong Institution of Production Engineers.

It would be very appropriate that, from the Chair, he should say on behalf of all the members how much they appreciated the work done by the permanent staff of the Institution. The Secretary expressed the thanks of himself and his colleagues.

The proceedings then terminated.

REPORT ON ELECTION OF MEMBERS TO COUNCIL

In accordance with Article of Association No. 33(c) six of the twelve elected Members of Council (five Members, one Associate Member) retired by rotation.

For the six vacancies for elected Members, ten nominations were received. As a result of the ballot conducted in accordance with Article of Association No. 35, the following were elected :—

Mr. A. J. Aiers, M.I.Mech.E.
Mr. B. H. Dyson, F.I.I.A.
Mr. P. G. Garside, A.M.I.Mech.E.
Mr. B. G. L. Jackman, A.F.R.Ae.S., M.I.I.A.
Mr. H. J. Swift, O.B.E.

For the one vacancy for the elected Associate Member, two nominations were received. The Associate Member elected was :—

Mr. J. E. Burnett.

Ballot papers were circulated to 5,100 Corporate Members in the United Kingdom.

Details of the voting issued by the Institution's Auditors are as follows :—

Eligible papers included in the ballot		1,306
Rejected :—		
Incorrect number of votes recorded	30	
Papers not marked in ink ...	9	
Spoiled papers	3	
Envelopes unsealed	2	
Incorrectly marked	4	
Papers received after closing date	27	
	—	75
Total number of ballot papers returned		1,381

The full list of Council Members for the current year is published in the Journal.

REPORT OF COUNCIL

1st July, 1951 to 30th June, 1952.

TO BE PRESENTED BY THE CHAIRMAN OF COUNCIL AT THE ANNUAL GENERAL MEETING 29th JANUARY, 1953.

THE year 1951/52 may well prove to be a very significant one in the Institution's history. There was a general feeling expressed at Council Meetings that the Institution's administrative machinery and organisation should be examined, to see if any improvements could be made in the way the Institution's affairs are conducted. The President, General Appleyard, gave expression to this feeling when he proposed that a Special Committee on Organisation should be set up. The decision was actually made at the Council Meeting held in April 1951, that is, in the previous year, and, in fact, was reported upon by Mr. Puckey in the report to the General Meeting last year. It might be as well, however, to refresh members' memories as to the aims and objects of this Committee. The terms of reference were framed generally to guide the Committee on the following lines:—

"To raise the status of the Institution and the standard and effectiveness of the membership and the profession".

I had the honour to be elected Chairman of this Committee and my colleagues were Major-General K. C. Appleyard, Mr. J. Blakiston, Mr. E. D. Broome, Mr. R. S. Brown, Mr. H. Gardner, Mr. J. E. Hill, Mr. B. G. L. Jackman, Mr. R. W. Mann, Mr. A. Oppenheimer, Mr. W. C. Puckey, Dr. H. Schofield and Mr. C. H. T. Williams.

The Council were careful to appoint to the Committee a number of senior members who had not played a significant part in the affairs of the Institution for some years past, and thus were able to bring to the Committee some fresh thoughts unbiased by existing practice. After many months of deliberation, my Committee produced a Report which was circulated to all Section Committees, who were given several months to study the proposals before Council was called upon to make any decisions. The Report aroused a considerable amount of comment and many Sections had criticisms to make, some on major points of principle, some on minor points of detail, but eventually at the Council Meeting held on 24th April, 1952, Council decided to adopt the Report in its entirety.

There were some proposals in the Report which came within Council's powers of immediate action and, as a result, some of these proposals have already been put into effect. One of the major proposals was a complete revision of the Journal, and members will have already seen the first issue of the new Journal, which they received on or about 1st January. There will be some members, no doubt, who will not like the new format. That is understandable; after 30 years of a Journal of a particular size, the introduction of a different size may cause a certain amount of inconvenience and possibly conservative

objection, but my Committee were convinced, after the most careful examination of many other professional Journals, that the new size was the best one to adopt. We are now committed to publishing this Journal for some period ahead and I would ask all members, therefore, to withhold their judgment for the time being, to study carefully the material which is published in the Journal over a period of months and to form their final opinion when they have had time to examine a series of issues.

Standing Committees

One or two other proposals of my Committee affected the set-up of our Standing Committees. It was our view that the then Technical and Publications Committee could not be expected to handle all the work of producing a new type of Journal and, at the same time, of taking all the steps that were necessary to improve the level of papers which it was hoped to publish. For this reason, it was recommended that the Technical and Publications Committee should be brought to an end and two new Committees set up in its place. These two new Committees were to be known as the Editorial Committee and as the Papers Committee.

The Editorial Committee is to have the entire responsibility for producing the Journal and all the work that this involves. The Papers Committee, as its name suggests, is to be primarily concerned with all the work in connection with papers. The Papers Committee is set up to assist Sections in getting good papers for their Local Section Meetings; they have the task of reading all the Institution papers that are submitted at Section or national level or at Conferences and elsewhere; to assess them and to decide whether or not they are suitable for publication in the Journal. The Papers Committee will also have the task of adjudicating upon all papers submitted for Institution Awards and it will be their duty to recommend to Council the names of authors who should be invited to prepare the Institution's named Papers such as the Sir Alfred Herbert Paper, the Viscount Nuffield Paper and the George Bray Memorial Lecture.

I really believe that if these two Committees fulfil the duties that have been placed upon them, then the whole level of the Institution's professional work will be considerably raised.

I should like to take this opportunity of recording the Council's deep appreciation of the many years of loyal service rendered to the Institution by the members of the Technical and Publications Committee.

Some of the proposals which were made by my Committee could not be adopted in full by Council. These proposals involve changes to the Articles of Association which require the approval of members in General Meeting. Accordingly, amendments to the Articles of Association have been drafted and will shortly be circulated to all corporate members of the Institution for them to study, prior to their being submitted to an Extraordinary General Meeting, which will probably be called in April, when members will have an opportunity of approving or disapproving of the proposals, by voting for or against as their consciences dictate. Members will have the assurance that all the proposals have been very carefully examined by Council and that they all have Council's support.

The principal changes involved in the Articles of Association is the grouping of all the existing Sections of the Institution into Regions. The growth in membership of the Institution is bringing about the establishment of more and more Local Sections. We have in Great Britain now no less than 28 full Sections, 6 Sub-Sections and 12 Graduate Sections in addition to those Sections set up in Australia (3 Sections), India (2 Sections), Canada, New Zealand and South Africa.

Our Constitution provides that every Section shall have its President serving on the Council of the Institution and where the membership exceeds 200 or 400, as the case may be, Sections have another one or two representatives serving on Council. The effect of this, of course, is that the Council gets bigger and bigger, and bigger, and consequently more and more unwieldy. By grouping the existing Sections into Regions, this difficult problem could be resolved. The proposals are that Section Chairmen—and it is proposed that the existing title of President should be changed to Chairman—and other representatives of Local Sections will form a Regional Committee, which will have the responsibility of co-ordinating all the work of Local Sections within the Region. Sections will continue to be self-governing just as they are to-day, and Regional Committees will have no overriding powers. Their function will be to unite the work of all the Sections in the Region and to provide advice and guidance where it is required. Regional Committees will have the responsibility of assisting Sections to form their programmes. They will arrange Regional Meetings, Regional Conferences and other functions where a regional arrangement would be more satisfactory than a purely local one.

It is proposed that the Regional Chairmen and, possibly, other representatives of the Regions, will then form the Institution's Council, with the addition of the elected members and other officers. In this way the Council will become considerably smaller than it is at present and its ultimate number will be fairly stable. I believe myself that this will promote better government within the Institution, without in any way interfering with the existing freedom of Local Sections in managing their own affairs.

The Institution has existed on its present Constitution, with amendments from time to time, for the past 31 years. My Committee believe that in framing these proposals for adjustments to the Constitution, that machinery will be provided which will enable the Institution to go forward for another 30 years or more with as much success as in the past.

Members should most seriously consider the proposals from this point of view. They should discount their immediate reaction and the possible immediate effect upon their Local Section activities, and consider rather the long-term effect upon the Institution's Constitution and whether or not the proposals will enable the Institution to go ahead even more rapidly than in the past.

Finance

All members will have had an opportunity of studying the Balance Sheet and Statement of Income and Expenditure which was published in the January 1953 Journal. In accordance with the requirements of the Companies Act, the Accounts of the Sub-Councils in Australia and South Africa and of the Sections in Bombay, Calcutta and New Zealand have been amalgamated with the United Kingdom Accounts. The Accounts will be presented later in the Meeting, when members will have an opportunity of asking questions.

Members will observe that, during the year, there has been an excess of income over expenditure of £2,030. It is interesting to note that the Sections outside the United Kingdom are doing well and have contributed their share to this surplus.

I should like to mention, however, that the liquid position of the Institution appears to be at its worst at the Balance Sheet date, when, invariably, there is an overdraft on the Head Office bank account. This is not due to any mismanagement on the part of the Finance and General Purposes Committee, but rather because the Institution's income for the year is not due until July 1st, the day after the date of the Accounts. In actual fact, within one day of the Balance Sheet date the bank balance commences to swell rapidly to a credit of many thousands of pounds and it remains in substantial credit for approximately 11 months of each year.

It may be thought that with an accumulated surplus on the Income and Expenditure Account of £9,399, further appropriations should be made to specific funds, but, so far as possible, the Finance Committee prefer to adopt the sound method of backing such appropriations with invested securities and, in this connection, it has to be noted that a considerable proportion of our current assets are with our Overseas Sections, where there may be local Treasury restrictions prohibiting the remittance of funds to London. In actual fact the current assets include:—

Cash with Overseas Sections ..	£2,564
United Building Society, South Africa, Deposit Account	£1,650
	£4,214

Thus, you will see that the good position reflected in the Balance Sheet is to a quite considerable extent represented by liquid assets outside the United Kingdom, which are not necessarily available for immediate investment by our Head Office here in London. It is desirable, of course, that our Sections outside the United Kingdom should have adequate financial resources at their command.

Having in mind the period of inflation through which we have been passing for the past few years, I believe that we can feel reasonably satisfied with our financial position. We have been enabled again in the past 12 months to operate all our Institution facilities and yet show a surplus of income over expenditure exceeding £2,000. It is essential that we should continue to operate on this basis for a number of years to come. The time is not very far distant when we are faced with the difficult task of securing new Institution Headquarters. The Secretary of the Institution has inspected many properties. Some of them are suitable and some of them are entirely unsuitable for use as Headquarters, but all of them have so far been prohibitively expensive. There is little doubt that the Institution will require a large capital sum, within the next few years, to enable us to buy new and suitable Headquarters and we shall have to direct all our energies to this end.

I can assure you that the Finance and General Purposes Committee, of which I am Chairman, pay the greatest attention to all financial matters. Budgets are very carefully considered and our income and expenditure is always planned at least 12 months ahead. No expenditure is incurred unless the Finance Committee are fully satisfied that it is justified. One rule, for example, which the Committee always endeavour to operate is that all special functions of the Institution outside the normal day-to-day business, should be self-supporting. I refer to such efforts as National Conferences, Annual Dinners, Weekend Schools, the Summer School and all special functions of that kind. We consider it fair and reasonable that where special facilities of this nature are provided, the members who are able to take advantage of them should be charged a small fee to cover the cost so that they shall not be a burden on Institution funds.

Education

Undoubtedly, the most important aspect of the Institution's work at the present time is the development of education for production engineering. At a rough estimate, industry needs an intake every year of men specifically trained as Production Engineers of the order of 2,000 or more, yet the number of young men entering the industry through the recognised training as Production Engineers is not many more than 200. The Institution's Education Committee are making a close study of the needs of industry, with a view to shaping the Institution's education policy so as to provide industry with the number of properly trained men that it needs every year.

During the past year, there has been not only an increase in the provision of facilities for the study of production engineering, but also considerable discussion and experiment as to the desirable content of the courses. The expansion of facilities for training has not yet been matched by a corresponding use of the facilities by industry. All members can help by making sure that where courses exist, their apprentices and student Production Engineers are encouraged to attend them.

The Associate Membership Examination has been generally accepted and I can report an achievement of great significance in the development of the Institution. This was the acceptance of the Associate Membership Examination (subject to certain qualifying conditions) by the Burnham Committee of the Ministry of Education as a Graduate equivalent for salary purposes for teachers. It should not, however, be assumed that this represents finality in the form of the Examination, which must keep abreast of scientific development.

It was stated in the Chairman's Report last year that an increase in the number of candidates taking the Examination was expected. This has, in fact, taken place during the year under review. The period has also seen a considerable increase in the numbers of Junior Members, which is in part due to the enhanced attraction of qualification by the new Examination.

The decisions of the Government concerning the Development of Higher Technological Education have also been made known in broad outline and these are reflected in the deliberations of the Education Committee. A further development of considerable interest has been the expansion of the Institution's educational service, not only to members, but through representation on various national and local bodies.

Only one Schofield Travel Scholarship was awarded in 1952, to Mr. D. C. Howard, who carried out his project in Switzerland and Germany. Messrs. F. W. Walton and A. H. Needham, the 1951 Schofield Scholars, have given excellent accounts of their visits abroad and have obviously benefited very much through the opportunities of the Scholarships.

The success of the Third Annual Summer School held at Ashorne Hill was due in no small measure to the enthusiastic support of the Midlands Sections.

The Institution has approved conditions for the award of an Institution Prize in connection with the scheme for the Higher National Certificate in Production Engineering. This award will be additional to those prizes already presented jointly with the Institution of Mechanical Engineers.

Mr. J. France has been elected to serve as Chairman of the Education Committee in succession to Mr. W. E. Park.

Membership

Our membership continued to grow during the year and the total number of members on 30th June 1952 was 9,186, a nett increase of 448 over the previous year. The following figures show the number of members in each grade and the corresponding number in the previous year:

	1952	1951
Honorary Members	8	9
Members	1,475	1,410
Associate Members	4,274	4,080
Intermediate Associate Members	288	349
Associates	158	161
Graduates	1,978	1,896
Students	804	645
Affiliated Firms	201	188
	9,186	8,738

Mr. R. L. Paice has been re-elected Chairman of the Membership Committee for the ensuing year.

Awards

The following awards were made during the year:—

Institution Medal—for the best Paper presented by a non-member for the year 1950/51 to:—

Mr. J. Redshaw, O.B.E., M.I.N.A., for his Paper entitled "Building an Ocean Liner".

Institution Medal—for the best Paper presented by a member during the year 1950/51 jointly to:—

Mr. P. K. Eisner for his Paper entitled "Tracer Controlled Machine Tools,"

and to

Mr. H. P. Jost, for his Paper entitled "Industrial Law and the Production Engineer".

Lord Austin Prize 1951—for the best essay by a Graduate to:—

Mr. J. Irwin for his essay entitled "The Automatic Production of Pressed Glassware".

Certificates of Merit were awarded to Mr. R. S. Cracknell and Mr. D. Whitehead.

Hutchinson Memorial Award 1950/51—for the best Paper presented by a Graduate jointly to:—

Mr. P. K. Eisner, for his Paper entitled "Tracer Controlled Machine Tools,"

and to

Mr. H. P. Jost, for his Paper entitled "Industrial Law and the Production Engineer".

Schofield Travel Scholarship 1952—was awarded to Mr. D. C. Howard.

Technical and Publications

Probably the most important service which the Technical and Publications Committee rendered to the Institution during its period of office was the establishment of the principle of having "Institution Papers". The first of these, known as the Sir Alfred Herbert Paper, was presented on 19th March, 1952, by Mr. F. H. Rolt, O.B.E., B.Sc., A.C.G.I., M.I.Mech.E., M.I.Prod.E., Superintendent of the Metrology Division of the National Physical Laboratory. About 400 members and guests attended the meeting at the Royal Empire Society, when the Paper was presented. The Paper and the discussion which took place at the meeting, together with the subsequent written contributions to the discussion, were published as the first in the series of Sir Alfred Herbert Papers. In view of the great interest aroused, Mr. Rolt is presenting the Paper to Regional Meetings of the Institution in other parts of the country.

During the coming year, other named Papers will be presented. Sir John Cockcroft, Director of the Atomic Energy Research Establishment at Harwell, has accepted Council's invitation to present the Sir Alfred Herbert Paper 1953. He will take as his subject "Industrial Applications of Atomic Energy" and it is expected that the meeting will take place during the Summer of 1953.

Major-General K. C. Appleyard, C.B.E., the immediate Past President of the Institution, has agreed to present the Viscount Nuffield Paper, probably in May 1953.

Another named Paper to be presented for the first time in the coming year will be the George Bray Memorial Lecture. The Directors of Messrs. George Bray and Co. Ltd., of Leeds, have very kindly

donated to the Institution the sum of £500, which your Council have invested. The income from this fund will be used every year to make an award to the author of the George Bray Memorial Lecture, which will commemorate the memory of Colonel George Bray, a Past President of the Yorkshire Section of the Institution and one who did immense work for the Institution behind the scenes over a period of many years. In making possible the annual presentation of this Paper, the Directors of the Company have expressed a wish that the subject chosen each year should be the application of the science of production engineering in spheres with which it is not traditionally associated.

Strenuous efforts were made by the Technical and Publications Committee to maintain a high level of papers to be published in the Journal. The Editorial Committee and the Papers Committee which superseded the Technical and Publications Committee in 1952, have been set the highest standards of attainment by their predecessors. Mr. M. Seaman has been elected the first Chairman of the Editorial Committee and Mr. W. J. T. Dimmock, the first Chairman of the Papers Committee.

Standardisation

The Standards Committee have continued their work in close collaboration with the British Standards Institution, who have expressed their appreciation of the valuable services rendered by our members. At present, 123 members of the Institution are serving on 101 B.S.I. Technical Committees.

Efforts have been made to ensure that firms appreciate the fact that suggestions concerning standardisation are welcomed. As a result a number of points were submitted to B.S.I. Members are invited to submit any suggestions they have on this subject and these will be considered by the Standards Committee and passed to the B.S.I.

Mr. C. M. Holloway has been re-elected Chairman for the Session 1952/53.

Research

The Joint Committee on the Measurement of Productivity, which was set up jointly with the Institute of Cost and Works Accountants in 1948, under the auspices of the Research Committees of both Institutions, have recently published a Report on "Measurement of Productivity—Work Study Application and Training", which has been very favourably received by both the national and technical press and has aroused considerable interest throughout the country.

The Joint Committee are in the process of setting up Sub-Committees to prepare reports on "Measurement of Productivity—Production Control" and "Measurement of Productivity—Works Statistics". It is anticipated that the findings of these two Sub-Committees will be complementary to each other and will be published in one Report.

The Materials Handling Sub-Committee, under the Chairmanship of Mr. T. W. Elkington, has been engaged in the preparation of a Memorandum on Materials Handling Practice in British Industry and it is anticipated that this Report will be published in the early months of 1953.

It had been proposed to carry out a Survey in connection with this Memorandum but, following the results obtained from a pilot questionnaire and from recommendations received from firms participating therein, it has been agreed that the Survey should be undertaken industry by industry. This step will enable the Sub-Committee to make comparisons as between one organisation and another and to put forward recommendations of value to the industry as a whole.

A number of Case Studies have been assembled, in conjunction with the Anglo-American Council on Productivity; originally it was intended that these should form part of the Memorandum, but they will now be published as a separate document early in 1953.

A Bibliography on Materials Handling has been prepared and will be reproduced in the Memorandum.

The Sub-Committee were instrumental in organising a One-Day Conference at the Mechanical Handling Exhibition at Olympia on 7th June 1952. The Conference was divided into two Sessions, at each of which two Papers were presented, followed by discussion.

The Sub-Committee are now devoting their energies to the educational aspects of Materials Handling and are preparing a syllabus, in collaboration with Mr. T. B. Worth, the Institution's Education Officer.

Sir Lionel Kearns has been re-elected Chairman of the Committee for the Session 1952/53 and Mr. B. H. Dyson has been re-elected Vice-Chairman for the same period.

Hazleton Memorial Library

The physical growth of the Library in the past twelve months is apparent to anyone who visits the Headquarters at Portman Square. Additional shelving has been erected and greatly improved facilities are offered to members. The Library stock is over 1,500 volumes and 1,000 pamphlets. In addition, more than 170 periodicals are regularly received.

The Library Committee, under the Chairmanship of Lord Sempill and the Vice-Chairmanship of Mr. H. G. Shakeshaft, who was also Chairman of the Maintenance Sub-Committee, have been striving to make the collection as widely representative of production engineering interests as possible.

The information service is in many ways the most important part of the Library's work, and the Committee hope that more and more members will take advantage of it. Queries are received daily by letter, telephone, or personally from members all over the United Kingdom. They cover a very wide field, often far beyond the accepted spheres of production engineering. Sometimes a telephone call or the despatch of a single book or pamphlet will suffice to answer the query; sometimes a bulky parcel of journals has to be sent through the post; sometimes a bibliography has to be prepared, or loans negotiated from other libraries. Sometimes the information can best be obtained through personal contacts or telephone calls to persons or organisations who have special knowledge of the subject; and sometimes, too, it

seems to be a problem on which there is very little recorded information, or in which the member concerned will possibly be pioneering new ground.

Side by side with developing the information service, the Library Committee aim to make known to members some of the new material which is added to the Library. Hence they prepare, with the assistance of members from all over the country, abstracts and reviews of recently published books. The popularity of this service can be seen from the number of requests which are received for the titles mentioned in recent issues of the Journal.

Lord Sempill has been re-elected Chairman and Mr. J. C. Z. Martin has been elected Vice-Chairman of the Committee.

Local Section Activities

Your Council are encouraged by the evidence of enthusiasm and activity noticeable in all Sections and the Institution is indeed indebted to the Officers and Committees of Local Sections for the valuable work which they have contributed. During the year, nearly 300 Lecture Meetings have been held in the United Kingdom and 50 in Sections outside the United Kingdom. Many varied social functions and Works visits have also taken place.

The West Wales and Shrewsbury Sub-Sections have made great strides and have been granted full Section status, also a Graduate Section has been formed in Sheffield. A Sub-Section of the Eastern Counties has been formed in Norwich and this is now firmly established. During the year covered by this Report, negotiations were continued with a view to setting up Sub-Sections in Gloucester and Oxford, and as you will no doubt be aware, these have now been established.

A Conference of Graduate Section Representatives was held in March and was very well attended.

In May, a Conference of Section Honorary Secretaries was held, when many administrative problems of the Institution were discussed. Mr. E. H. Y. Burden, Honorary Secretary of the Bombay Section, was able to attend and made a very valuable contribution to the proceedings.

The Sections of the Institution outside the United Kingdom are flourishing and there is evidence of continued activity and enthusiasm ; it is also pleasing to record that the membership of all these Sections is still steadily increasing. In Africa, the proposed formation of a Section in Rhodesia is still under consideration by the South African Sub-Council. The visit of the President, Major-General K. C. Appleyard, to Canada, did much to advance the Institution's work in that country and the Section is now well established.

A number of members from Sections outside Great Britain have visited us during the year. Overseas members are always made very welcome at Institution Headquarters and at Section Meetings. At the same time, members from Great Britain have visited parts of the Commonwealth and Empire, where they have been most cordially received by our fellow members in those countries.

I cannot speak too highly of the value to the Institution of the work so willingly performed for the Institution by all its voluntary officers in our Local Sections. Their constant devotion to duty and the many hours of hard work which they perform in promoting Institution activities is of inestimable value.

Anglo-American Council on Productivity

The Institution continued to work closely with the Anglo-American Council on Productivity and was able to give assistance, on many occasions, in nominating suitable men to join the various Specialist Teams which were sent to the United States under the auspices of the Council. The Anglo-American Council on Productivity has now been brought to an end and I should like to record here, on behalf of the Institution, our appreciation of the immensely valuable work which the Council has done for British industry during its years of existence. A new body, known as the British Productivity Council, has been set up to take its place. The policy of the new Council has not yet been made known and we are not yet fully aware of what it might do. Nevertheless, I can assure the Council, on behalf of the Institution, that it will continue to receive our fullest support.

Meetings of Council

Your Council has met four times during the year, to conduct the routine business of the Institution. In addition, considerable time has been devoted at Council Meetings to discussion of important matters of Institution policy. Reports of the Council Meetings have been published in the Journal.

Services of Members

In his Report last year, Mr. Puckey laid emphasis on the value to the Institution of the voluntary services of members. I can only underline what he said. The strength of a Professional Institution is dependent upon the voluntary contributions made by the members of the profession. Our Institution, through our Local Section organisation, is enabled to have the support and help of a very large number of members. There is evidence that more and more members are taking an active interest in the work of the Institution and are themselves prepared to make direct contributions.

Headquarters Staff

I would like to place on record my appreciation of the devotion to duty and to the Institution displayed by the Staff, and I can assure you this view is shared by the Council as a whole.

Mr. Woodford has made marked progress and advanced in status since his appointment as Secretary, and has justified the confidence placed in him. In his endeavours, he has been ably assisted by his Chief Assistants, Mr. Knight and Mr. Caselton, and indeed by all the Staff at Headquarters.

In appreciating the tremendous amount of voluntary work which is done for the Institution by members, I think it should be borne in mind that this would be impossible if it were not for this attitude of mind which is a characteristic of all the Staff, and makes it such a pleasure to work with them.

Honours

It is recorded with very great pleasure that the following members have been honoured by the Sovereign during the year:—

Sir Cecil Weir . . K.C.M.G.	Colonel F. G. Thorpe . . Kt.
R. F. Newman . . C.B.E.	F. J. Chard . . M.B.E.
W. C. Holden . . M.B.E.	H. O. Norwood . . M.B.E.
J. Skinner . . M.B.E.	G. Swain . . M.B.E.

Obituary

It is with regret that the deaths of 37 members during the year must be recorded. Their names have been published in the Journal.

Conclusion

Finally, I think it my duty to point out to you that this Report refers to the Financial Year ending 30th June, 1952, and therefore covers the work done by my predecessor, Mr. W. Puckey. Indeed, I feel that he should have presented it, but in accordance with our normal practice, I find myself in the position of giving you some information with regard to the work done by the Institution under his direction. This permits me to pay tribute to his outstanding contribution to the Institution in the two years during which he was Chairman of Council. He set a standard which I find extremely difficult to follow, and I am certain that his name will be associated

(continued on opposite page).

THE INSTITUTION OF PRODUCTION ENGINEERS

BALANCE SHEET as at 30th JUNE, 1952

1951		£	£
	Accumulated Funds and Surplus		
25,027	The Viscount Nuffield Gift ...	25,027	
100	The Lord Austin Prize Fund ...	100	
100	The Hutchinson Memorial Fund	100	
—	The George Bray Memorial Fund	500	
2,000	New Building Fund	2,000	
			27,727
1,653	Leasehold Premises Sinking Fund	1,780	
1,000	Dilapidations Reserve Fund ...	1,100	
			2,880
739	Life Subscriptions: *less* amount transferred to Income and Expenditure Account ...		864
7,369	Income and Expenditure Account		9,399
37,988			40,870
433	Hazleton Memorial Library ...	5	
51	Melbourne Prize Account ...	51	
			56
59	Schofield Scholarship		387
	Current Liabilities		
3,852	Sundry Creditors	3,076	
218	Subscriptions received in advance	331	
1,138	Bank Overdraft : *less* Sections and Cash Balances	2,325	
			5,732
43,739			£47,045

1951		£	£
	Fixed Assets		
3,481	Leasehold Premises at cost (Depreciation is provided by a Sinking Fund)		3,481
	Furniture, Fittings and Plant at the net amount standing in the Institution's books at 30th June, 1948	1,531	
	Additions	3,875	
		5,406	
	Less Depreciation to date ...	1,294	
4,227			4,112
25,227	Fund Investments at cost: as scheduled ... ... (Market value £21,795)		27,727
2,653	Sinking Fund Policies: as scheduled (Premiums paid) ...		2,880
35,588			38,200
	Current Assets		
5,283	Sundry Debtors, Deposits and Stocks	5,884	
1,134	General Investments at cost : as scheduled ... ... (Market value £814)	1,134	
1,250	United Building Society—Deposit (South Africa)	1,650	
484	Cash at Bank— Hazleton Memorial Library and Melbourne Prize Accounts	177	
			8,845
43,739			£47,045

CECIL M. WEIR, *President.*
H. BURKE,
Chairman of Council and Finance Committee.
W. F. S. WOODFORD, *Secretary.*

Report of the Auditors to the Members of The Institution of Production Engineers.

We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit. In our opinion proper books of account have been kept by the Institution so far as appears from our examination of those books. Audited Balance Sheets and Accounts have been received from each of the Overseas Sub-Councils and these have been incorporated in the above Balance Sheet and annexed Income and Expenditure Account. We have examined the above Balance Sheet and annexed Income and Expenditure Account which are in agreement with the books of account audited by us and the audited Sub-Councils Accounts supplied to us. No provision has been made for reductions in value of invested funds. In our opinion and to the best of our information and according to the explanations given us the said Accounts give the information required by the Companies Act, 1948, in the manner so required and the Balance Sheet gives a true and fair view of the state of the Institution's affairs as at 30th June, 1952, and the Income and Expenditure Account gives a true and fair view of the excess of income over expenditure for the year ended on that date.

20, Bloomsbury Square,
London, W.C.1.
11*th October,* 1952.

GIBSON, APPLEBY AND CO.,
Auditors,
Chartered Accountants.

with many progressive moves within the Institution for some considerable time to come.

I would also like to refer to General Appleyard, who was our National President during the period now under review. I have very happy memories of his Presidency, and I am sure that members will share with me the stimulation and great encouragement which one always received after spending some time with him. During the time when he was President Elect for one year, and subsequently President for two years, he did not spare himself in visiting Sections all over Great Britain and Overseas. He was at all times willing to devote his time, thought and energy to the well-being of the Institution and we owe him a deep debt of gratitude.

The Institution is particularly fortunate in being able to secure the services of such eminent Industrialists. It is in this category that we welcome Sir Cecil Weir as successor to General Appleyard, and we have already felt the impact of Sir Cecil's great

(continued over page).

INCOME and EXPENDITURE ACCOUNT for the year ended 30th JUNE, 1952.

1951		£	£
	To **Establishment Charges**		
240	Rent and Water Rate ...	241	
1,042	Light, Heat and Cleaning	1,049	
375	Repairs and Renewals ...	357	
			1,647
	,, **Administration Expenses**		
1,606	Postage and Telephone ...	1,894	
3,399	Printing and Stationery ...	3,522	
53	Professional Charges and Insurance	81	
225	Audit Fee	300	
2,406	Travel, Entertaining and Meetings (other than Sections)	2,353	
363	Miscellaneous	208	
			8,358
14,318	,, **Salaries**		15,304
	,, **Section Expenses**		
1,607	United Kingdom	1,893	
2,110	Overseas (Audit Fees £93)	2,053	
1,000	Central Services	911	
			4,857
	,, **Journal**		
9,631	Printing	10,639	
1,188	Postage and Envelopes ...	1,750	
—	Institution Papers ...	700	
542	Reporting	400	
			13,489
164	,, **Donations and Grants** ...		138
	,, **Miscellaneous**		
373	Dinner—October 2nd, 1951	45	
322	Schofield Travel Scholarship	—	
94	Cost of Appointments Bulletin (Net)	—	
—	Mechanical Handling Exhibition	112	
—	Presidential Regalia ...	145	
6	Summer School 1951 ...	44	
			346
	,, **Provisions**		
436	Depreciation — Furniture and Fittings	476	
100	Dilapidations Reserve ...	100	
127	Leasehold Sinking Fund ...	127	
500	Schofield Scholarships 1952	500	
			1,203
2,759	,, **Balance**—Excess of Income over Expenditure carried down		2,030
44,986			£47,372

1951		£	£
	By **Subscriptions**		
25,873	Renewals and Arrears ...	27,987	
433	Transfers	281	
2,379	New	1,496	
3,321	Overseas	3,747	
1,587	Entrance Fees	885	
			34,396
1,104	,, **Interest**		1,023
10,193	,, **Journal Receipts**		11,768
96	,, **Sale of Publications**		185
44,986			£47,372

APPROPRIATION ACCOUNT

1951		£	£
2,000	To Transfer to New Building Fund		—
7,369	Balance carried forward ...		9,399
9,369			£9,399

1951		£	£
6,608	By Balance at 1st July, 1951 ...		7,369
2,759	Excess of Income over Expenditure brought down ...		2,030
2	Profit on Sale of Investments		—
9,369			£9,399

administrative ability, knowledge and wisdom at Council and Committee Meetings. As has already been announced, he has now been appointed by Her Majesty's Government as Leader of the United Kingdom Delegation to the High Authority of the European Coal and Steel Community at Luxembourg, commonly known as the "Schumann Plan." While we regard this appointment as an honour to the Institution, we have to recognise that in the future, Sir Cecil will have less time for Institution work than he would have wished. I am sure that you would like to join me in extending to him our thanks for accepting the office of President and our good wishes for his future career.

INVESTMENTS 30th JUNE, 1952.

	£	s.	d.	£	s.	d.
SCHEDULE OF FUND INVESTMENTS						
The Viscount Nuffield Gift						
£7,124 19s. 10d. 3½ per cent. War Stock	7,428	19	8			
£8,554 9s. 0d. 3½ per cent. Treasury Stock, 1977/80	8,598	4	2			
£9,038 0s. 0d. 4 per cent. Canadian Pacific Railway Perpetual Consolidated Debenture Stock	9,000	0	0			
				25,027	3	10
The Lord Austin Prize Fund						
£95 8s. 5d. 3½ per cent. War Stock				100	0	0
The Hutchinson Memorial Fund						
£95 8s. 5d. 3½ per cent. War Stock				100	0	0
The George Bray Memorial Fund						
£775 0s. 9d. London County 3 per cent. Consolidated Stock, 1920				500	0	0
New Building Fund						
£2,102 1s. 6d. 3 per cent. Savings Bonds, 1955/65				2,000	0	0
				£27,727	3	10
SCHEDULE OF SINKING FUND POLICIES						
Leasehold Premises Sinking Fund						
Norwich Union Life Insurance Society Policy—Premium Paid ...				1,780	6	8
Dilapidations Reserve Fund						
General Accident Fire and Life Assurance Corporation Ltd. Policy —Premium Paid				1,100	0	0
				£2,880	6	8
SCHEDULE OF GENERAL INVESTMENTS (Unallocated)						
£274 12s. 0d. 3½ per cent. War Stock				290	0	0
£151 4s. 6d. 3½ per cent. Treasury Stock				152	0	1
£382 13s. 8d. 3½ per cent. War Stock				400	0	0
£190 16s. 11d. 3½ per cent. War Stock				200	0	0
£37 17s. 3d. 3½ per cent. War Stock				40	0	0
£50 2s. 6d. 3½ per cent. War Stock				52	10	0
				£1,134	10	1

Continued from page 36.

tion Engineers, who will have to consider this matter very seriously in the future.

In further support of this principle, which is based as Mr. Woollard has mentioned on the "Unit system of Machine Tooling", is the fact that even at the end of the particular contract under review, much of the plant is reclaimable and can be built into other set-ups.

Good handling schemes do dispense with some labour, and do create some redundancy, which up to the present time has not been serious due to full employment, but in face of world competition there can be no going back and the ultimate aim must be to reduce laborious work, produce better quality goods at cheaper prices, upgrade men from labouring jobs to become operatives and promote greater interest in the overall factors of efficient production.

This paper of Mr. Woollard's opens the door to new thought on this subject, and maybe industry as a whole will be grateful to the motor industry for showing the way.

NOTE: Comment is invited on papers published in the Journal. Contributions which should be brief and to the point should be addressed to the Editor, 36 Portman Square, London, W.1.

SOME IMPRESSIONS OF A VISIT TO THE UNITED KINGDOM

by J. B. ARNOLD, M.I.Prod.E.

Mr. Arnold, who is a member of the Melbourne Section of the Institution, and director of a number of companies with wide and varied activities, spent some time in the United Kingdom last year, during the course of a business tour.

IT is very difficult for a visitor to observe the things that really matter, because there are always a great many complementary media that are not visible to the casual observer; it is mostly wrong to make detailed deductions based on observations derived from a wide field of vision. I would like to make it clear, therefore, that the following notes record purely personal impressions.

I had not been in the U.K. since 1938—the longest period I have spent without visiting this lovely country. It is lovely because, amongst other things, you have your particular brand of weather. England without its rainy days that are meat for the music-hall comedian would not be the most garden-like piece of this planet. Therefore, when anybody apologises to me for English weather, I reply that I like England as she is.

The climate of your country conditions a lot of your thinking. You must have heat to warm homes and offices and nowhere else in the world is solid fuel, burned in individual grates, used to such an extent. Consequently (even though modern grates are more efficient) no place I know has the dirt problem that arises from the great volume of flue gases over places like London. Once, when I commented on this to a Londoner who now lives in Australia but has a very great nostalgia for London, he said "Yes, but it's nice dirt". That remark made me realise that one should always think carefully before drawing conclusions and one of the observations I have made in this country is that, taking all factors into account, the most efficient way of heating most of London is solid fuel in modern individual grates. So my friend, who is not the slightest bit technical, was right—it is nice dirt.

Viewing the U.K. from 12,000 miles for fourteen years, during which period a war had been fought and won, and a post-war rehabilitation offering greater problems than war was being worked out, it is natural that one's impression will not be a true picture. I was enthusiastic when I arrived in England to see how the U.K. compared with the picture I had built up during the past fourteen years.

Comparison with the U.S.A.

In the main, the picture I had in my mind was not very different from the conditions I found. My thoughts were a little confused by the fact that I had spent a month in the U.S.A. on my way here, and saw the inside of several industrial organisations. It so happened that the first factories I visited in this country were much smaller than those I had seen in America and my immediate thoughts were: "How can these industries compete in world markets?" No doubt there are some companies, not only the small ones but big organisations in this country, who have not done enough forward thinking, and they will probably die of attrition unless a cure is taken.

The cure is in progress in most of the works I visited and particularly the small ones. There is a small non-ferrous mill in the Midlands whose roots go back to the eighteenth century and I will always remember with pleasure the two keen young engineers who showed me round. It was a joy to see their grasp of all the problems and their readiness to admit certain things were wrong but, at the same time, to argue that some methods which appeared out of date suited their particular type of production, and they really knew the reasons why.

Evidence of Industrial Progress

Another factory, close to London, is achieving a fantastically high output with inadequate works and store facilities; but the executives are good, keen, young men and very joyful that they are at present planning a completely new factory on a bare site, which in my opinion will considerably reduce their costs.

The real thrill of my visit to this country has not been an engineering works, although it is the facilities that have been developed by engineers that makes the place so exciting. I refer to a wool spinning mill in Darlington. Here I saw the completion of a brain child that was not planned until 1945 and, although of very great dimensions, it was starting to function by 1947. Today it is a beautiful and full-grown specimen and I use the word "beautiful" in the full sense of its meaning.

The textile industry in this country is one of your oldest and, no doubt, many of your textile companies are living a little bit on tradition. In fact, it is an industry in which tradition and "know-how" of individuals plays a great part; so it is even more meritorious that this industry should have planned on such a radical basis.

Not only are there immediately visible all the modern ideas of dining-rooms, well-lighted offices, gardens, excellent facilities in the way of steam plant,

handling facilities and the things that can be bought off the shelf, if one goes to the right place to find them (in this case, the shopping has been done in the right place, because the more or less mundane equipment for steam raising and handling is beautifully suited to the jobs in hand) but, in addition, new, untried modern machinery of a very radical nature has been installed. I understand there were a few teething troubles but the firm are now being rewarded with very much higher production.

To me the ideas behind this spinning mill should be the goal of all industry in the United Kingdom. I do not mean in detail, but in thought. It is no good being satisfied with what you have, and it is only by a great deal of co-operation, from people who are trained in all aspects of production, that a new project can be successful. I am sure that it is the young, enthusiastic engineers who are production-minded who will contribute a great deal to your country during the next few years.

A MESSAGE FROM THE CANADIAN SECTION OF THE INSTITUTION

SIR Wilfred Laurier, Canada's Prime Minister from 1896 to 1911, once stated that the twentieth century belonged to Canada. The development of the country's natural resources and her spectacular industrial growth bids fair to make this prophecy come true. The discovery of enormous oil deposits in the West providing abundant supplies of oil and natural gas, the iron ore mining operations of Labrador with an estimated output of ten million tons *per annum* of high quality ore by 1955, the building of one of the world's largest aluminium plants in Kitimat, British Columbia, are all examples of the remarkable development of Canada's natural resources.

C. J. Luby, Chairman, Canadian Section Committee

Industry has not been slow in utilising the advantages conferred by duty-free raw materials combined with cheap water power, and is determined to place the economy on a sound industrial footing. Imports of finished goods are being steadily reduced in proportion to domestic manufacture and, at the same time, a well equipped and highly efficient defence industry is being built up which, in happier times, can largely be devoted to home production.

Thus it can be seen that the basis of the national economy is rapidly changing from purely extractive to one in which the production of goods is playing an increasingly important part. In 1939, 658,000 of a total population of 11,267,000, were engaged in manufacturing industries, while at the present employment in these industries has increased to 1,100,000 in a population of 14,430,000.

While Canada's record of achievement over the past decade is little short of miraculous for a population which as yet is only equivalent to the combined urban population of Britain's two largest cities, there is no doubt that future progress must depend to a large extent on the availability of skilled engineering technicians in every branch of industry. In this respect, the Institution of Production Engineers can make a considerable contribution in overcoming the shortage of well trained Production Engineers. It is unfortunately true, however, that as yet Canadian industry, while productivity conscious, does not as a whole recognise production engineering as a separate and distinct function of industry and, as a consequence, few facilities exist today which provide for any form of education or training in the science of production.

The long-term objective before the Canadian Section, therefore, is to establish production engineering as a profession in Canadian industry and to encourage the development of suitable courses at technical schools and universities, leading to the equivalent of National Certificate and Associate Membership standards in Great Britain. Viewed from our present position in Canada we realise that we have a tremendous task ahead of us ; we plan to expand our present membership of 98, practically all of whom are Production Engineers from home, by the inclusion of a wide cross-section of Canadian trained engineers with the right qualifications and experience in Canada. As a result of recent publicity following Mr. Harold Burke's visit in September, we have had enquiries from over sixty interested people —which is some indication of the awareness of the need for more concentration on production engineering techniques. Already we have an established lecture programme, and with the strengthening of our membership we expect to be able to widen the scope of our activities by such means as giving assistance to Government bodies, educational authorities and industry in general. Thus we hope to achieve that recognition of production engineering which is so vital to the Section's future and, we believe, to Canada as a whole.

T. H. Beard
Canadian Section Hon. Secretary

In this brief message I have endeavoured to convey, on behalf of the Committee, some idea of the aims of the Canadian Section, the difficulties which we have to overcome and the importance of those aims in relation to industry. What the Institution has done and continues to do so well in Great Britain, we sincerely hope to equal for Canada in the future. Much hard work lies ahead of us but with the help so readily given by Council and Headquarter's Staff, we look forward to the day when the Institution is able to function as well in Canada as it does elsewhere in the Commonwealth.

CYRIL J. LUBY.

BRITISH PRODUCTIVITY COUNCIL

The British Productivity Council, which was formally established last November, has been organised on a broader basis than its predecessor, the U.K. Section of the Anglo-American Council on Productivity, whose work it is taking over as well as engaging in fresh activities.

In addition to representatives of the British Employers' Confederation, the Federation of British Industries and the Trades Union Congress—the constituent bodies of the A.A.C.P. since its inception—the Council includes representatives of the Association of British Chambers of Commerce, the National Union of Manufacturers, and the nationalised industries.

Sir Peter Bennett has been appointed first Chairman of the Council, with Mr. Lincoln Evans as Deputy Chairman.

The Council's aim is to seek to engage the active interest of industry in the pursuit of high productivity, and to give it all possible help in its independent activities. (See page 2)

WHITWORTH SCHOLARSHIPS

The Minister of Education, as Trustee of the Foundation of Sir Joseph Whitworth, will offer for competition in 1953 the following awards :-

a) Two Whitworth Senior Scholarships, tenable for two years, of the value of £325 *per annum*.
b) Five Whitworth Scholarships, tenable for three years, of the value of £200 *per annum*. The Minister may increase this amount, having regard to the funds available, the expenses of the course, and the needs of the scholar.
c) Prizes of £20 each, not exceeding ten in number, to unsuccessful candidates for Whitworth Scholarships, whose work deserves recognition. A prize will not be awarded to a competitor who has won a prize in a previous year.

Full details of these awards will be found in " Regulations and Syllabus for Whitworth Scholarships, 1951 " which may be obtained, price 4d. (by post 5½d.) from H.M. Stationery Office, or through any bookseller. Entry forms are obtainable on application to The Secretary, Ministry of Education (Awards Branch), Curzon Street, London, W.1., and must be completed and returned *not later than 15th January, 1953.*

MODERN AMERICAN FACTORIES

On January 20th, a paper on " Modern American Factories " will be read at the Royal Institute of British Architects, 66 Portland Place, London, W.1., by Mr. W. A. Allen, B.Arch., A.R.I.B.A., of the Department of Scientific and Industrial Research, Building Research Station, Watford.

The author recently spent a period in the U.S.A. with the principal American factory designers studying the principles on which they work, and the paper will discuss in detail planning, structural design, heating, ventilation and lighting practice.

Interested members of the Institution of Production Engineers are cordially invited to attend this meeting, which will commence at 6 p.m.

Typical displays at the Northern Productivity Exhibition

THE NORTHERN PRODUCTIVITY EXHIBITION

30th October/6th November, 1952

It is surprising to find that in the traditionally "heavy" engineering district of the North East Coast, "light" industries now employ as many people as are engaged in ship building and repairing. The wide diversity of trades in the area was illustrated at the successful Productivity Exhibition held in Newcastle-on-Tyne from the 30th October to the 6th November 1952. The Exhibition, which was staged at the Northumberland Baths Hall, was officially opened by the Minister of Supply, the Right Honourable Duncan Sandys, and attracted many thousands of visitors.

It was the aim of the Exhibition to interest all workers, from office boy to Managing Director, and to stimulate thought on the subject of Productivity, which would lead to profitable action. Practical, live demonstrations of what has been done, what is being done and what can be done by employers and employees in the area were the focal points of the Exhibition. These working examples were arranged in the centre of the Exhibition space and were surrounded by stands and display panels which presented a sequence of ideas bearing on Productivity. In addition industrial films with a productivity bias were shown at frequent intervals.

The arrangement of stands was so skilful that visitors were led in a natural sequence right through the Exhibition.

To introduce the Exhibition, nine display panels proclaimed some of the fundamental points of Productivity and underlined the predominant theme which was—"Higher output can be achieved through the combined effort of management and workers".

Fuel and Power

After the introduction came a series of stands on the basic "power" industries—Coal, Electricity, Oil and Gas. The stands illustrated how productivity was increased and then showed how the "power" industries assist efficient production. A working model of the " Lambton-Worm," a coal truck tipper designed to facilitate the unloading of coal, was one of the examples of the application of better methods in the " power " industries. The use of town gas for flame hardening of gears, and the use of electricity for the automatic sorting of products were other examples in this section.

Materials Saving, Work Study, Costing and Production Control

The Fuel and Power Section was followed by display panels on Materials Saving, Work Study and Costing and Production Control. The materials saving panels emphasised how valuable material can be saved by ingenious ideas and improved methods. The Work Study Section, which was contributed by the North East Section of the Institution, gave some thirty practical ideas, from all levels of labour, which have increased Productivity.

Materials handling was illustrated by photographs of better handling methods in use in North East factories; an informative chart displayed a works measurement system which is in use, and photographs of a North East foundry before and after reorganisation showed the advantages of an efficiently planned works layout. The Costing and Production Control Section gave typical examples of standard cost accounting and production control paper-work stressing the importance of costing and production control.

Colour in Industry

Does colour in industry affect productivity? Is the correct use of colour and light a stimulant to higher productivity? The intelligent observer could not fail to ask himself these questions after studying the interesting examples of colour and light phenomena displayed in this Section of the Exhibition. In common with the other stands this display did not seek to instruct, but rather to show ideas which would stimulate thought and lead to action.

University and Technical Colleges

King's College, Newcastle, of the University of Durham, made a valuable contribution to the Exhibition which demonstrated the ever growing part which the University is playing in industrial research. The contribution was divided into three parts and consisted of:—

(*a*) The problem of making the machine fit the man so that the man-machine unit works at the highest efficiency peak.

(*b*) Aspects of University research into production engineering problems.

(*c*) The application of physical chemistry in the solution of industrial difficulties.

Of particular interest was the stand designed and built by students of the technical colleges of the Region, which showed how the knowledge of Productivity is spread among students.

Building Trade

The stand devoted to the building trade displayed two models of building sites. One of the models was a typical example of bad planning and the other showed good planning.

Workpeople's Suggestions

A portrait gallery was created from a representative selection of North Eastern workpeople and their productivity ideas. Emphasis was laid on the many workers whose ingenuity had helped themselves or others to do their jobs more efficiently and the importance of encouraging work improvement suggestions was stressed.

Safety

A Section of the Exhibition was devoted to examples of bad practice which had resulted in serious accidents to workers. Many useful safety promoting ideas were demonstrated.

Mutual Aid

The last display panel in the sequence dealt with mutual aid between firms arranged by the North East Engineering Bureau. Actual cases of mutual aid were quoted such as the provision by one firm to another of a component which could not be obtained immediately from other sources, but which was necessary to complete an important order.

Improved Methods

The centre stands, giving practical working examples, attracted considerable interest. The improved methods which were shown are all in use in North East factories and related to gauging in engineering, sectional systems in clothes making, work study applied to tin-making machinery and more efficient packaging methods. An example of the application of motion study to simple process work was demonstrated by two workers wrapping bottles of shampoo in cardboard containers. One of the workers was able to wrap 38 per cent. more bottles than the other worker by the use of a simple jig.

Radio-active isotopes produced at the Harwell Atomic Research Establishment provide new tools for industry and one of the stands included a scale model of Britain's first atomic pile, and illustrated some of the ways in which isotopes can help industrial processes.

The Management Committee of the Exhibition, under the able and vigorous Chairmanship of Mr. R. W. Mann, M.I.Prod.E., Past President of the North Eastern Section, are to be congratulated on staging, in the national interest, such a widely representative Exhibition. There can be little doubt that a wider application of the principles so strikingly displayed would increase productivity in this country and inevitably lead to greater national prosperity.

NEWS OF MEMBERS

MR. H. BURKE, CHAIRMAN OF COUNCIL

Mr. Harold Burke, M.I.Mech.E., M.I.Prod.E., F.I.I.A., Director and General Manager of Concentric Manufacturing Co. Ltd., Birmingham, and Director of a Subsidiary Company, Metaducts, Ltd., Brentford, has been appointed Joint Managing Director of the Parent Company. He has also been elected a Director of the Subsidiary Companies, Rowmill Metals, Ltd., and T. Miller, Ltd., Birmingham.

PROFESSOR T. U. MATTHEW

At the request of the Indian Government, the United Nations Organisation has sent to India a Technical Assistance Mission for the purpose of studying the application of payment by results systems in that country. Heading the Mission, which will spend six months on the project, is Professor T. U. Matthew, Head of the Department of Engineering Production at the University of Birmingham, who is a member of the Research Committee and Materials Handling Sub-Committee of the Institution.

SECTION HON. SECRETARIES—CHANGE OF OFFICE

While regretfully accepting the resignation from office of Mr. C. Pullen, of Melbourne, and Mr. R. M. Buckle, of Luton, Council wish to record their very deep appreciation of the hard work and invaluable support of these officers. Without the loyalty and enthusiasm of members who undertake the many onerous duties of Section Hon. Secretary, the Institution would find it difficult to maintain and increase its activities and progress.

Mr. Pullen has held office as Honorary Secretary of the Australian Sub-Council and Honorary

OBITUARY

The Institution records with profound regret the death of Mr. J. S. Daniels, Member, and Chairman of T. H. & J. Daniels, Limited, Stroud, after 63 years in the service of the firm.

Mr. Daniels was born in October, 1874, and on leaving school entered the family firm of T. H. & J. Daniels Limited, of Stroud, Gloucester. After serving an apprenticeship he had experience on the sales and design side before becoming Works Manager and, in 1900, a Director of the Company.

It was as Chairman of the Company that he was elected a full member of the Institution in June, 1939, and he at once began to play an active part in Institution activities. He became President of the Western Section in 1942 and during the next ten years served on Council, the Finance and General Purposes Committee and the Membership Committee. He will be particularly remembered by his colleagues on the Membership Committee, to which he devoted his attention during the past seven years. He was a most regular attender in spite of recurring illness and the long distance which he had to travel to meetings, and his wise counsel and experienced judgment will be very greatly missed.

Mr. Daniels was also a leading member of the Institution of Mechanical Engineers and a past President of the Gloucestershire Engineering Society.

Secretary of the Melbourne Section for more than eight years, and has relinquished these positions because of ill-health. His knowledge and vast experience in Institution affairs will be greatly missed in Australia.

Mr. Pullen, who was born in Warwickshire, became a member of the Institution in 1930, and has always taken a very active part in its affairs. He emigrated to Australia in 1942, and it is in no small way due to his untiring efforts and enthusiasm that the Institution has acquired its present stature and importance in Australia.

Mr. Pullen's successor as Section Hon. Secretary, is Mr. R. W. Deutsher, Associate Member: Mr. L. W. Worthington, Associate Member, takes office as Hon. Secretary to the Sub Council.

Mr. Buckle is resigning the office of Honorary Secretary of the Luton Section due to pressure of business, after 12½ years in this capacity. He became a member of the Institution in 1934, and has always had its interests very much at heart.

The Institution is very much indebted to Mr. Buckle for his hard work not only as Section Secretary, but also as a member of the recently-dissolved Technical and Publications Committee. It is good to know that whilst the Luton Section will be losing his services as Honorary Secretary, he will still remain on the Section Committee which will, therefore, continue to benefit from his long experience and knowledge of Institution affairs.

The new Luton Section Secretary is Mr. J. F. W. Galyer, Associate Member.

RETIREMENT OF MR. G. H. ALLEN

Mr. George H. Allen, Member, has retired from his position as Manager of the Southampton branch of Harland & Wolff, Ltd., after 38 years with the firm.

After serving his apprenticeship at North Shields, Mr. Allen obtained his chief engineer's certificate at sea, and then entered the drawing office at Smith's Dock, South Bank, where he became foreman engineer. He joined Harland & Wolff in Liverpool, in 1914, and moved to Southampton three years later.

Mr. Allen is a Past President of the Southern Section of the Institution, and a member of the Institute of Marine Engineers. From 1948 until early this year, he was Chairman of the South Coast Shipbuilding and Engineering Employers' Association, having held office as Deputy Chairman during the Second World War.

SCHOLARSHIP AWARD

Mr. D. N. Cledwyn-Davies, Graduate, who gained his M.Sc. degree at the University of Bristol last year, was recently awarded a Post-Graduate Scholarship to the Institute of Technology, Massachusetts, U.S.A.

NEW APPOINTMENTS

Mr. A. T. Alisop, Associate Member, of the Foster Instrument Company, has been appointed Manager of their new factory at Clacton-on-Sea.

Mr. A. H. A. Bastable, Associate Member, has been appointed General Manager of the Harper Aircraft Co. Ltd., Exeter.

Mr. J. M. Beattie, Associate Member, has taken an appointment as Experimental Officer in the Engineering Services Division of The Admiralty Signal & Radar Establishment, Portsmouth.

Mr. E. Fletcher, Associate Member, has been appointed Production Engineer in the Mobile Engineering Department of Newton Chambers & Co. Ltd., Sheffield.

Mr. J. A. Grainger, Associate Member, is now employed by Rolls-Royce Ltd., Derby, in the Process Development Department.

Mr. L. C. Holmes, Member, has been appointed Production Engineer to the Nigerian Railway, Lagos, for a tour of from 18 to 24 months.

Mr. D. B. Melton, Associate Member, has been appointed Production Controller of Blackstone Ltd., Stamford, Lincs.

Mr. G. R. Parry, Associate Member, has joined the Boston Marine Patents Co. Ltd., as Chief Engineer.

Major J. H. Partridge, Member, until recently Master of the India Government Mints at Calcutta and Alipore, has joined the staff of Wickman Ltd., Coventry.

Mr. J. R. Pettigrew, Associate Member, has been appointed Works Manager of John Fowler & Co. (Leeds) Ltd., Leeds.

Mr. W. P. Shead, Associate Member, is now Works Manager of Southern Instruments Ltd., Camberley.

Mr. Charles Toeman, Associate Member, has relinquished his appointment as Works Manager of C. F. Casella & Co. Ltd., and is now in business on his own account as a Production Consultant.

Mr. C. Walker, Associate Member, is employed as a Senior Planning Engineer attached to the Oil Engine Division of Rolls-Royce Ltd., Derby.

Mr. H. Barclay, Graduate, has been appointed Planning Engineer at the Plessey Co. Ltd., Ilford.

Mr. D. C. Bear, Graduate, has been appointed Production Manager of Iso-Speedic Co. Ltd., Warwick. Previously, Mr. Bear was Assistant Works Manager of this Company.

Mr. G. R. Burn, Graduate, has taken a new appointment as Assistant Principal Lecturer in Work Study with the Engineering & Allied Employers West of England Association, Bristol.

Mr. C. Leah, Graduate, has taken an appointment as a Teacher of Engineering Subjects with the Essex Education Committee.

Mr. J. Pearce, Graduate, has taken an appointment as Planning Engineer with the Bristol Aeroplane Co. Ltd., Sunderland.

INSTITUTION NOTES

ASSOCIATE MEMBERSHIP EXAMINATION

The Associate Membership Examination of the Institution of Production Engineers will be held from Monday, 18th May, to Saturday, 23rd May, 1953, inclusive.

All applicants must complete the appropriate form of Application for Membership and return it to Head Office not later than 1st March, 1953. These forms will be assessed by the Council before applicants are accepted as candidates for the examination. No examination entry form is required.

Application forms, copies of the Examination Regulations and copies of the 1951 and 1952 Examination Papers (price 2/-), may be obtained from the Head Office of the Institution.

INTERESTING LIBRARY ADDITION

An interesting and unusual acquisition to the Hazleton Memorial Library recently is a treatise "On the Economy of Machinery and Manufactures," by Charles Babbage. Published in 1832, this is the third edition of a book which in some respects antedates F. W. Taylor's work by seventy years.

The Library copy was presented by the author to Charles (later Sir Charles) Lyell, the geologist, and is inscribed in his own hand.

REGIONAL MEETING AT HALIFAX

A Regional Meeting of the Institution—the first in the area—was held on 4th November, 1952, when 200 members of the Halifax, Sheffield and Yorkshire Sections met at the George Hotel, Huddersfield, to hear a reading of The 1952 Sir Alfred Herbert Paper, "The Development of Engineering Metrology" by the author, Mr. F. H. Rolt, O.B.E., B.Sc., A.C.G.I., M.I.Mech.E., M.I.Prod.E.

The Chair was taken by Mr. J. Blakiston, M.I.Mech.E., M.I.Brit.F., M.I.Prod.E., Halifax Section President, supported by Mr. G. R. Pryor, Vice-Chairman of Council and Sheffield Section Vice-President, and Mr. S. G. Haithwaite, M.I.Prod.E., President of the Yorkshire Section.

Following a short address by Mr. Rolt, the discussion was opened by MR. T. P. N. BURNESS (Joint Managing Director, William Asquith Ltd., Halifax), who remarked on the wonderful service to industry rendered by the National Physical Laboratory. Mr. Burness recalled his experience during the First World War, when accurate measurement presented a very serious problem, and also referred to his experience in connection with fuel pumps and atomisers, where interchangeable lap fits were required.

Institution Visit to Trostre

This photograph was taken on the occasion of the Institution's official visit to the Trostre Works of the Steel Company of Wales, on 29th October, 1952. The visit, which was arranged by the West Wales Section, was very well attended, the Institution's party being led by the President, Sir Cecil Weir, K.C.M.G. (centre). On either side of the President (left to right) are Mr. R. G. Boland (W. Wales Section Committee) ; Mr. W. F. S. Woodford, Institution Secretary ; Capt. Leighton Davies, C.B.E. (W. Wales Section President) ; and Mr. G. R. Pryor, Vice-Chairman of Council. In the front row (extreme left) is Mr. H. P. Sanderson, Hon. Secretary, West Wales Section, who organised the visit.

He had once been questioned by the late Dr. Schlesinger for illustrating by a straight line the surface finish achieved, but by a spilt-up of guides and plungers he had convinced Dr. Schlesinger that this was possible to an accuracy of a quarter-of-a-tenth.

Mr. Rolt, referring to fuel pumps, asked Mr. Burness if he had met with trouble with the lap fit changing with time, as one of the main difficulties in the production of slip gauges was in the finding of a steel which would remain constant after heat treatment.

Mr. Burness replied that this had been the case but, by a process of elimination, a low-growth steel had been found and this had reduced the errors to an almost negligible amount, which had been a great step in the conversion of the solid injection engine.

Mr. F. J. Everest, (Vice-President of the Halifax Section), remarking on the simplicity of the slip gauge, mentioned a total elongation of 20 millionths, over eight years, in a particular 4" slip gauge which had never left the Standards Room. He thought the production of a stable steel was long overdue.

He also recommended that research should now be concentrated on the introduction of robust and simple devices for the use of machine operators.

Mr. Rolt supported Mr. Everest's view that machine operators should have a set of first-class gauges of their own. He thought the stage was slowly approaching when the inspector would find his place alongside the operators; he should be there as an advisor and form part of the production unit.

The need for accurate, portable measuring instruments for use in the heavier engineering industry was outlined by Mr. E. Levesley, (Hon. Secretary, Sheffield Section). In his experience, he had not found anything to surpass the old water level for the measurement of long machine tool beds, etc., as when used properly this instrument was most reliable. The influence of vibrations was the main difficulty.

Changing shop temperatures due to doors being continually opened and shut were also stated to be adverse factors.

Mr. Levesley asked the author if he knew of any workshop means of checking taper screw threads. Mr. Rolt was not very conversant with this type of work, but said he could see no reason, if the lathe were checked for accuracy of pitch and correct taper, and the tool of true form, why the threads should not be cut satisfactorily.

Mr. Rolt said he was most interested in the speaker's remarks concerning measuring equipment for larger work—shafts of 36" diameter and over, for example. He had recently been reading of the development of a certain German technique for this purpose, using measuring instruments made of wood, designed in a lattice type of structure to make it rigid. This was, of course, subject to changes in size according to the humidity, but this had been overcome to a large extent by casing the wood in aluminium foil, which was then lacquered.

Mr. Rolt stated that he intended to write a paper on this subject in the not too distant future.

In reply to other questions, Mr. Rolt emphasised how the yard had been defined by an ancient Act of Parliament as the distance between two lines marked on a certain brass bar when at 62°F. He explained how it was possible to compare the Standard Yard with the Standard Metre, at any temperature, provided the coefficients of expansion for the two materials were known.

The sensitivity of level comparators for the testing of slip gauges was outlined, and as an example of the magnification it was stated that a difference of a hundred-thousandth of an inch between two gauges would show a movement on the scale of 0.2".

Mr. Rolt was asked if he had found changes in the angle when cutting screw threads, and in reply, he stated that if a flat top cutting tool were used and set exactly at centre height, a 60° angle would be maintained.

Vote of Thanks

Mr. I. G. Hopkinson (immediate Past President, Halifax Section), then proposed a sincere vote of thanks to Mr. Rolt, on behalf of the Halifax, Sheffield and Yorkshire Sections and all the visitors present, and this was seconded by Mr. R. S. Cracknell, Chairman of the Halifax Graduate Section.

Mr. Rolt expressed himself as overwhelmed with the reception he had received, and was only sorry that he had not time to answer in more detail the very interesting questions which had been asked.

Western Section Dinner Dance

The Dinner Dance held by the Western Section at the Berkeley Café, Clifton, on 16th October, 1952, was a most enjoyable function, and the Committee are to be congratulated on their organisation. The principal guests, shown in the accompanying photograph, were (left to right), Mrs. E. F. Gilberthorpe; Mrs. A. E. Russell; Dr. A. E. Russell; Mrs. G. W. Wright; Mrs. W. F. S. Woodford; The Lord Mayor of Bristol; Mr. Harold Burke, Chairman of Council; The Lady Mayoress; Mr. W. F. S. Woodford, Institution Secretary; Mr. G. W. Wright, Section President; and Mr. E. F. Gilberthorpe, Section Vice-President.

HAZLETON MEMORIAL LIBRARY

Members are asked to note that the Library will be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week, and from 9.30 a.m. to 12.30 p.m. on Saturdays. Due to Meetings, the full facilities will not be available at the following times during this month :—

Wednesday, 7th January, from midday.
Thursday, 8th January, all day.
Tuesday, 13th January, from midday.
Tuesday, 27th January, from midday.
Thursday, 29th January, all day.

It would be helpful if, in addition to the title, the author's name and the classification number could be quoted when borrowing books.

REVIEW

658.23 FACTORY LAYOUT ; PLANNING

"Factory Planning and Plant Layout" by William Grant Ireson. *Prentice Hall, New York.* 1952. 385 *pages. Illustrated. Diagrams.* 45s.

The author has covered a subject of extremely wide range in a practical and determined manner. His work is based on current American practice and gives numerous illustrations of the application of factory planning and plant layout in American industry today.

The subject matter details the fundamental requirements of efficient factory layouts from the angles of both large and small establishments and moves through factory planning, factory layouts, material handling, services and building factors.

The production and economic analyses make an effective contribution, and the author has appreciated the consideration of personnel and welfare necessities in an article which includes employment, training, comfort and recreation of employees and their effect in relation to factory efficiency. A.R.N.

ABSTRACTS

658. INDUSTRIAL ORGANISATION ; MANAGEMENT

"Rationalisierung durch Planarbeit" (Rationalisation through Planning) by Curt Hanfland. *Institut fur Planarbeit, Stuttgart.* 1949. 412 *pages. Charts.* DM. 22.50

This book deals with planning in the widest sense, applied to industry. Not only are technical and commercial planning, as well as labour relations, applied to various manufacturing stages, but the book also ranges into political economy in general and current German economic planning in particular.

The volume is divided into three parts :—Fundamentals, Development of Basic Types, and Future, and further sub-divided into 14 Sections :—Conceptions, Introduction into the Planwork System, Organisational Assumptions, Plan Structures, Psychology, Directives, Management, Commercial Structure, Development and Construction, Planning and Preliminary Calculations, Manufacturing and Ordering, Production, Inspection, Results of Planning.

The book contains an index as well as a table of contents.

621.7 WORKSHOP PRACTICE

"Workshop Practice : A Practical Text Book" by Ernest Pull. (9th Ed.) Rev. by P. S. Houghton. *Technical Press, London.* 1952. 739 *pages. Illustrated. Diagrams.* £1 4s.

This book deals with the well-known workshop tools and techniques, and a variety of measuring tools and gauges, fitters' tools, and machine tools is described.

There are chapters on bench work and on machine tool operation, including screwcutting and gear manufacture. A section on welding and fabricating describes elementary processes in this subject. Many common engineering materials are briefly specified in one chapter, while another deals with the making of wrought iron and steel. Heat treatment, partly with rather large-scale equipment, is referred to.

The book is illustrated with line drawings and photographs.

331.215 JOB EVALUATION

"Job Evaluation : A Practical Guide" by British Institute of Management. *The Institute, London.* 1951. 80 *pages.* 7s. 6d. (Personnel Management Series 4.)

This manual, described as a practical guide, consists of some 12,000 words, with five appendices, and was prepared by a panel under the aegis of the British Institute of Management.

The booklet defines Job Evaluation to be the process of determining, without regard to personalities, the work of one job in relation to that of another. This process of determination is exposed in five steps, with an introductory chapter, describing the purposes and limitations of Job Evaluation.

First, a thorough examination of the job to be assessed is undertaken, and from this is prepared a "Job Description", which records the job characteristics in a manner most suited to the method of assessment. A comparison is then made of one job with another, by one of several methods, varying from overall judgment of the whole job to a detailed consideration of a number of factors. The jobs are arrayed in a progression according to some numerical measure, or by broad comparison. Finally, this progression is related to a money scale, to obtain the relative monetary worth of each job.

The manual also illustrates the difficulties that may beset the Manager when attempting the introduction of Job Evaluation.

The booklet contains, in the form of appendices, examples of Job Descriptions, Wage Scale Curves, Evaluation Systems, a Glossary of Terms, and Bibliography.

510. MATHEMATICS

"Elementary Mathematics" by Lewis W. Phillips. *Macdonald & Co. Ltd., London.* 1952. 339 *pages.* 12s. 6d.

This textbook covers the field of mathematics that its title suggests. The author has set out to cover the syllabus in Elementary Mathematics for the examinations of the Royal Society of Arts and in doing this he has written a book which could be used by students about to study a National Certificate Course.

The text of the book is well laid out and simple to understand. The numerous examples and questions throughout the text will give the student the elementary grounding which is necessary before he can begin his higher education.

338.98 RELATIONS BETWEEN GOVERNMENT AND INDUSTRY

PEP (Political and Economic Planning), London. **"Government and Industry : A Survey of the Relations between the Government and Privately-Owned Industry."** 1952. 224 *pages.* £1 1s.

This is a survey of relations between the Government and privately-owned industries and is based on the work of a group consisting of a number of senior industrialists, civil servants, economists and others.

It contains a short history giving the background of Government intervention in industry, particularly dealing with the impact of the two World Wars.

It covers such subjects as the control of investment, taxation and credit policy, export and import licensing and controls, and the various controls exercised during

and since the war in the home market.

There is a chapter on Government organisation which should be of value to business men because of its description of the methods of operation of Government departments and their regional offices.

Some criticisms are made of both Government operation of control and of the attitude of firms in their dealings with the Government, and suggestions are made for improving the liaison between them.

621.86 MATERIALS HANDLING

"**Materials Handling in Industry**" by British Electrical Development Association. *The Association, London.* 1952. 142 *pages. Illustrated. Diagrams.* (Electricity and Productivity Series No. 4.)

This book gives descriptions and illustrations of the popular types of mechanical handling equipment, as well as a number of examples of special purpose equipment. After a brief description of the benefits of mechanical handling and of the relative factors concerned, it goes on to deal with applications and the various factors and rules which determine the choice of equipment.

It then goes on to descriptions, which have been grouped as follows:—

(1) Overhead runways and lifting equipment. Types of tracks with accessories such as switches, turntables, weighing sections, etc., types of trolleys and lifting blocks with details of current collection equipment for electric blocks.
(2) Cranes of various types, ranging from overhead travellers to jib cranes and portable stackers.
(3) Chain conveyors of various types, from overhead monorail chain conveyors to "en masse" and scraper conveyors.
(4) Elevators for packages and for loose materials.
(5) Roller conveyors, spiral chutes, belt, slat, screw and pneumatic conveyors.
(6) Floor transport and storage, stillages, pallets, trucks of all types including fork lift, pallet and elevating trucks.
(7) Vibrators of various kinds.

There follows a chapter on miscellaneous equipment; some case studies from actual installations, and appendices of equipment for handling packages and for bulk materials. There is also a list of British Standards dealing with mechanical handling equipment and in addition to the general index there is an additional index of materials, processes and situations dealt with in the book.

PAPERS RECEIVED

1909: "Work of the A.I.D. Test House" by W. N. Blacklock.
1910: "Standardisation" by Dr. H. E. Merritt.
1913: "Production and Culture" by K. S. Jewson.
1914: "Future Prospects of the Production Engineer" by W. C. Puckey.
1916: "Industrial Application of Porous Ceramics" by J. E. Poulter.
1917: "Examples of Economy in Material Usage."
1918: "Review of the Team Reports of the A.A.C.P." by A. G. Bradbury.
1920: "Tooling for Economical Production" by F. Baker.

OTHER ADDITIONS

621.852 BELTING

Duplex, *pseud.* "**Belt Drives in the Small Workshop.**" *Lond., Percival Marshall.* 1950. 64 *pages. Illustrated. Diagrams.* 3/6.

621.86 MATERIALS HANDLING

Anderson, T. McClurg. "**Manual Lifting and Handling.**" *Lond., Industrial Welfare Soc. Inc., in assoc. with Central Council for Physical Recreation.* 1952. 28 *pages. Illustrated.* 2/-.

Mechanical Handling Exhibition and Convention, No. 3, Olympia, 1952. **Papers Presented, Nos. 1-10.** *Lond., Louis Cassier Co. Ltd.* 1952. 12 *parts. Illustrated. Diagrams.*

Cleveland Crane and Engineering Co., Wickliffe, Ohio—Cleveland Tramrail Division. "**Cleveland Tramrail at Work.**" *Wickliffe, The Company.* 1950. 70 *pages. Illustrated. Diagrams.*

621.882 SCREWS; SCREW THREADS

Screw Thread Gages and Gaging. *New York, A.S.M.E.* 1951. 86 *pages.* $4.00. (American Standard ASA B1-1951.)

621.884 RIVETS; RIVETING PROCESSES

Aluminium Company of America, Pittsburgh, Pa. "**Riveting Alcoa Aluminium.**" *Pittsburgh, The Company.* 1950. 65 *pages. Illustrated. Diagrams. Tables.*

Aluminium Company of Canada Ltd., Montreal. "**Riveting Aluminium.**" *Montreal. The Company.* 1946. 104 *pages. Illustrated. Diagrams.* (Alcan Technical Books.)

Bailey, J. C., and Brace, A. W. "**Strength Tests on Driven Large Diameter Aluminium Rivets.**" *Lond., Alum. Devpt. Assoc.* 1952. 60 *pages. Illustrated. Diagrams.* 7/6. (Aluminium Development Assoc.—Research Report No. 13.)

621.9 MACHINE TOOLS; MACHINING

Crabtree, R. W. "**Machinability of Metals: Selected References.**" *Melbourne, C.S.I.R.O.* 1951. 7 *pages.*

Mounce, William, and Fifield, J. E. "**Role of Nickel in the Machine Tool Industry.**" *New York, International Nickel Co.* 1950. 30 *pages. Illustrated.*

621.91 PLANING; MILLING; REAMING

Cincinnati Milling Machine Co., Cincinnati, Ohio. "**Recommendations for Sharpening Carbide Milling Cutters.**" *Cincinnati, The Firm.* 1950. 16 *pages. Illustrated. Diagrams.*

621.92 GRINDING

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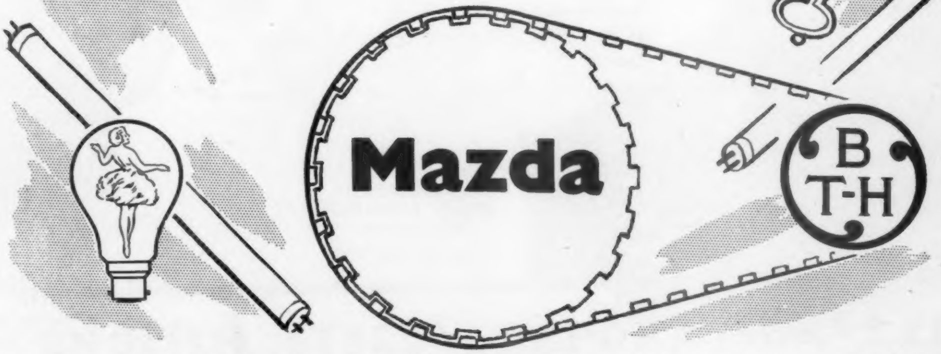

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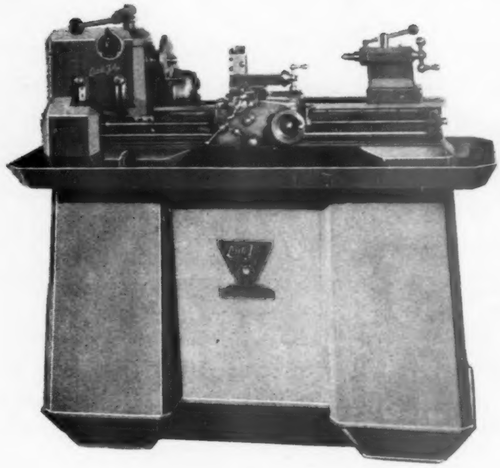

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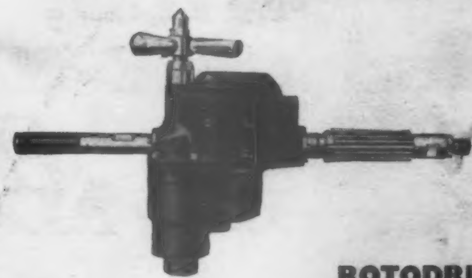

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